# UNILATERAL COMPLETE CLEFT LIP REPAIR: A MODERN MORPHO-FUNCTIONAL SURGICAL APPROACH

Srinivas Gosla Reddy

2010

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The Effect of Primary Cheilo-Septoplasty with Afroze Incision based on the Morpho Functional Philosophy in the Repair of Complete Unilateral Cleft Lip Defects

Een wetenschappelijke proeve op het gebied van de Medische Wetenschappen

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volgens besluit van het college van decanen
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A academic essay in Medical Sciences

DOCTORAL THESIS

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from Radboud University Nijmegen
on the authority of the Rector Magnificus, Prof. dr. S.C.J.J. Kortmann,
according to the decision of the Council of Deans
to be defended in public on Wednesday, November 17 2010
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**Paranimfen:**

Dr.Dr. Rajgopal Reddy

Dr. Srinath N

Dedicated to my masters and my patients

# CONTENTS

# CHAPTER 1

# General introduction

INTRODUCTION

The range of facial deformities is enormous. All produce some degree of disfigurement and result in the impairment of function to some degree, sometimes even to the point of incompatibility with life[1]. The most frequent congenital facial deformity is the unilateral (one sided) or bilateral (two sided) cleft lip, with or without cleft palate. Also isolated cleft palates without cleft lip are common. In general all these different types are called "cleft defects".

Orofacial clefts, particularly cleft lip with or without cleft palate (CL/P) and cleft palate only (CP) are a major public health problem affecting 1 in every 500 to 1000 births worldwide[2]. A child is born with a cleft somewhere in the world every two minutes according to a WHO study published in 2000[3]. In India it is estimated that 32.000 children (1.09:1000 births) are born with clefts every year[4].

Nowadays the Gold Standard for the treatment of cleft patients is a multidisciplinary team comprising of at least an operating surgeon, an orthodontist, a speech therapist and an ENT specialist[5]. Other team members of important value are a pediatrician, a specially trained nurse, a geneticist, a psychologist and technicians. An appropriate infrastructure is also needed to support the multidisciplinary team to provide comprehensive treatment for children with cleft defects. Nevertheless, setting up a gold standard multidisciplinary cleft team is not an easy task in Andhra Pradesh (India), where the research of this thesis was performed, but we tried it.

## CLASSIFICATION

In cleft defects there is a need for a good classification system, working in such a way that identifying a cleft is clear and simple. The most commonly used classification system for oral clefts is the striped Y classification[6], which was developed already in 1958 and later modified by Kernahan[7]. This classification system is mainly based on anatomical characteristics rather than treatment considerations. One of its shortcomings, however, is inadequate detail for recording cleft lips.

To plan the treatment of cleft lip defects, our institute (GSR Institute of Craniofacial Surgery, Hyderabad, India) developed its own classification. This classification is based upon the concept that a unilateral cleft lip is a combination of factors involving the lip, the alveolar ridges and the nose. The cleft lip defects are first divided into unilateral (complete or incomplete) or bilateral (complete of incomplete) clefts and then further subdivided depending on the extent and the morphology of the defect.

Figures 1 to 11 show the classification of unilateral cleft lips used at the authors institute.

Figure 11 shows an example of a patient with a typical complete unilateral cleft lip, alveolus and palate that has been classified according to the classification system as illustrated in the previous figures.

***Incomplete Unilateral Cleft Lip Defects***

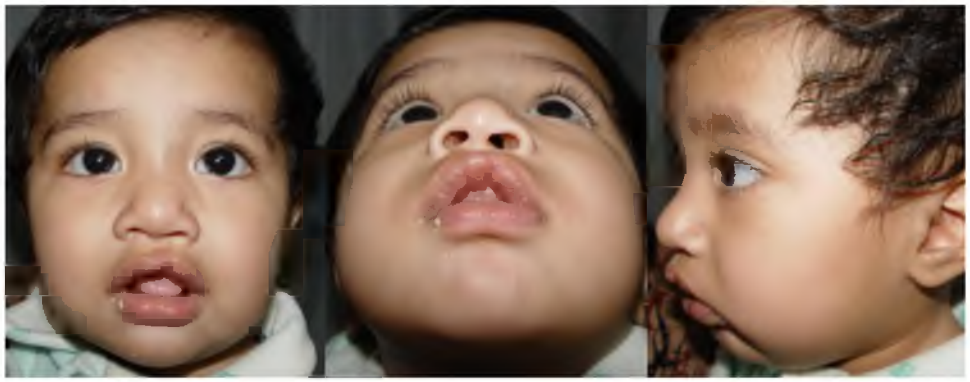

*Figure 1. Subcutaneous cleft (Type I)*

*Figure 2. Involving vermillion but not extending beyond the white roll (Type II)*

*Figure 3. Extending beyond the white roll but not involving the nose (Type III)*

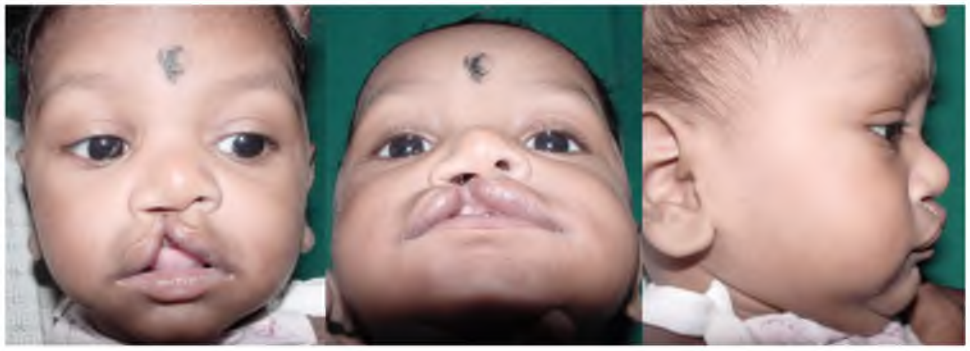

*Figure 4. Extending beyond the white roll involving the nose (Type IV)*

**C*omplete Unilateral Cleft Lip Defects***

*Figure 5. Without Simonart's Band (Type I a)*

*Figure 6. With Simonart's Band (Type I b)*

*Figure 7. Without complete collapse of nasal dome and ala (Type II a)*

*Figure 8. With complete collapse of nasal dome and ala (Type II b)*

*Figure 9. Without difference in level of alveolar ridges (Type III a)*

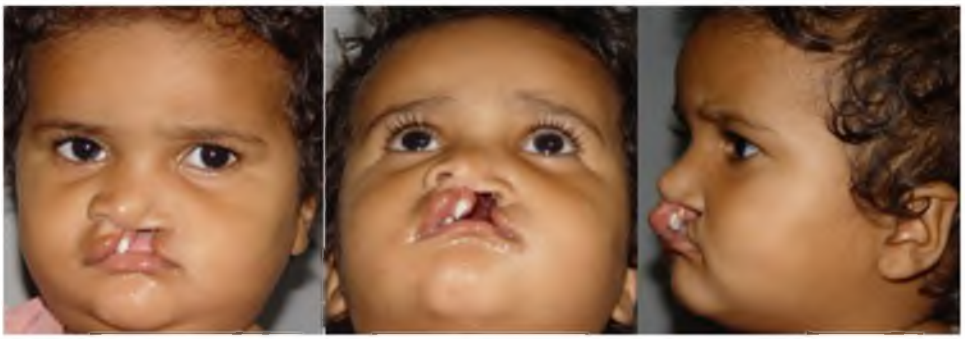

*Figure 10. With difference in level of alveolar ridges (Type III b)*

***A typical complete unilateral cleft lip can be classified as follows:***

*Figure 11. Complete left unilateral cleft lip, alveolus, hard and soft palate. No Simonarts band, complete obliteration of alar curve and with difference in the level of alveolar ridges.*

## AIMS AND OUTLINE

The goal of this thesis was to develop innovative treatment options for patients with a complete unilateral cleft lip and palate and evaluate the effect of the different approaches on treatment outcome.

This research for this thesis was performed in a high volume center in Hyderabad, Andhra Pradesh, India. India is the second most populated country in the world with a population of 1.02 billion[8]. Andhra Pradesh has a population of 76 million and is divided into 23 districts. Hyderabad is the capital city of the State of Andhra Pradesh in South India. Since there were no trustworthy epidemiological data about the cleft incidence in these region, a study in conjunction with the Government of Andhra Pradesh, was determined (Chapter 2).

The logical place to set up the institute was Hyderabad because this city is easily accessible to the surrounding states of Tamil Nadu, Karnataka, Maharashtra, Madhya Pradesh and Orissa. Setting up a complete stand-alone institution would initially have required large financial support; therefore the author started this project in an existing hospital. He recruited other consultants and formed a team that included a pediatrician, an otolaryngologist, a neurosurgeon, a speech therapist, an orthodontist and a general dentist. A core group of nurses was trained in managing infants and children with facial defects[4]. The complete workout of the setup of the cleft center in Hyderabad is described in Chapter 3.

One of the first things the cleft team had to deal with was the selection of the right patients. Indeed, a significant percentage of children born with cleft defects have also associated anomalies of other body structures[9-12]. These anomalies increase the burden of care for such children. It was therefore important to know the extent

of incidence of such anomalies in patients visiting the GSR Institute of Craniofacial Surgery (Chapter 4).

Having closed a cleft defect does not mean having a healthy patient. This is especially true since the World Health Organization (WHO) defines health as not only the absence of disease but also as the presence of factors that enhance physical, mental, and social well-being[13]. This has led to a broader conceptualization of overall health in a way that quality of life plays an essential role in this WHO-well-being concept. Therefore, this research included a high volume prospective Quality of Life (QOL) study of cleft patients in Andhra Pradesh (Chapter 5).

After having selected patients for cleft treatment the discussion about the most satisfying surgical technique started. Many techniques have been proposed and it is clearly apparent that no agreement exists as to which represents the optimal method. Historically, incisions have been either straight line or broken line, but more recently, in the twentieth century, flap designs developed over two distinct periods.

In the first, up to 1949, lengthening of the lip on the cleft side was achieved with some sacrifice of the ipsilateral Cupid's bow. This manoeuvre, however, tended to produce an aesthetically unfavourable peaking of the lip.

In the second half of the century, several attempts were made to counter this shortcoming. Tennison[14] utilized a triangular flap on the external surface of the lower margin of the lip, while Petit and Psaume[15] used a superiorly based flap. Nevertheless, because of scar contracture, this later approach also produced unacceptable aesthetic outcomes. A combination of superior and inferior flaps was used by Trauner[16] and Skoog[17] to counter these problems. A further alternative was described by Malek[18], who used a flap based on a precisely measured equilateral

triangle to achieve perfect equality in the length of the lip on both sides of the cleft. Not one technique of lip repair consistently produces ideal aesthetic and functional results. Among European cleft centers, two now well-established incision patterns for primary unilateral cleft lip repair are represented by the techniques of Millard[19] and Pfeifer[20]. These are examples of rotation-advancement and straight line methods, respectively. In this tradition a high volume (800 clefts) study was carried out by the author to compare outcomes attained using two different designs of skin incision used in primary closure of unilateral complete cleft lip (Chapter 6).

The aim of a unilateral cleft lip repair should be to achieve a lip length on the cleft side matching that on the normal side, to achieve an inconspicuous residual scar that does not cross anatomic boundaries, as well as to achieve an adequate Cupid's bow width, an absence of notching of the vermilion border (whistle tip deformity) as well as an absence of peaking of the vermilion at the Cupid's bow on the cleft side. Although a number of techniques (besides the two mentioned above) have been described for unilateral cleft lip repair, not one fulfilled all the above mentioned criteria and often cleft lip repairs require secondary operations to achieve this described goal[15]. Utilising the advantages of both techniques, the author developed a new technique, the so called Afroze incision technique. It is based upon a Milliard incision on the non-cleft side and Pfeiffer incision on the cleft side (Chapter 7).

After having passed the Afroze incision learning curve there was a need to compare the new technique with the Millard and Pfeifer techniques. Therefore a high volume (1200 clefts) study was conducted to compare the aesthetic and functional outcomes of the three different skin incisions and flap designs for primary unilateral cleft lip repair (Chapter 8).

Although the management of cleft lip and cleft alveolus has become more and more standardized over the past few decades management of the associated nasal deformity remains controversial. Furthermore, it is often the residual deformity of the nose, rather than that of the lip, which stigmatizes the contemporary older child or adolescent with a repaired cleft of the primary palate[21]. As in the lip repair the pursuit of perfection has resulted in a plethora of techniques and innovations to optimize results, the ultimate goal for repair of the cleft lip/nose deformity is also perfection, that is, to recreate normal oronasal form and function. It was postulated that doing a septoplasty plays a major role in the final aesthetic and functional outcome. Therefore the research project of the thesis was finished with a study to compare the outcome of lip and nose symmetry after complete unilateral cleft lip correction done with and without primary septoplasty using the Afroze incision (Chapter 9).

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# CHAPTER 2

# Prevalence of Cleft Lip & Palate in the state of Andhra Pradesh, South India

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ABSTRACT

Objective: To assess the incidence of cleft lip and palate defects in the state of Andhra Pradesh, South India.

Design Setting: The study was conducted in 2001 in the state of Andhra Pradesh, South India. Andhra Pradesh has a population of 76 million. Three districts, Cuddapah, Medak and Krishna, were identified for this study owing to their diversity: they were urban, semi urban and rural respectively. Literacy rates and consanguinity of the parents was elicited and was compared to national averages to find correlations to cleft births. Type and side of cleft were recorded to compare with other studies around the world and other parts of India.

Results: The birth rate of clefts was found to be 1.09 for every 1000 live births. This study found that 65% of the children born with clefts were males. The distribution of the type of cleft showed 33% had CL, 64% had CLP, 2% had CP and 1% had craniofacial clefts. Unilateral cleft lips were found in 79% of the patients. Of the unilateral cleft lips 64% were left sided. There was a significant correlation of children with clefts being born to parents who shared a consanguineous relationship and those who were illiterate with the Odds Ratio between 5.25 and 7.21 for consanguinity and between 1.55 and 5.85 for illiteracy respectively.

Conclusion: The birth rate of cleft was found to be comparable with other Asian studies, but lower than found in other studies in Caucasian populations and higher than in African populations. The incidence was found to be similar to other studies done in other parts of India. The distribution over the various types of cleft was comparable to that found in other studies.

## INTRODUCTION

Oral-facial clefts, particularly cleft lip with (CLP) or without cleft palate (CL) and cleft palate only (CP) are a major public health problem affecting 1 in every 500 to 1000 births worldwide[1,2]. A child is born with a cleft somewhere in the world every 2 minutes according to a WHO study published in 2000[3]. In India alone the number of infants born every year with CLP is 28,600, which means 78 affected infants are born every day, or 3 infants with clefts born every hour[4]..

India is the second most populated country in the world with a population of 1.02 billion[5]. For its administration it is divided into 28 states and 7 union territories. Each state is governed by an elected local government, while the union territories are governed by the Government of India directly through its representatives. Andhra Pradesh state is in the south of India.

The purpose of this study was to find out the prevalence of cleft lip and palate in Andhra Pradesh. This study was carried out by a high volume center in the state of Andhra Pradesh in association with the Government of Andhra Pradesh. The reason for the government's involvement with this project was to find out its impact on the health delivery system so that effective treatment could be given.

## STUDY DESIGN

*Andhra Pradesh* has a population of 76 million and is divided into 23 districts. Hyderabad is its capital city. The districts that were chosen for this study were Cuddapah, Medak and Krishna. They were chosen for their socio economical diversity.

Cuddapah district is a predominantly rural district that is drought prone and underdeveloped with the lowest per capita income in the state. The population has very little access to health care.
Medak is a semi-urban district. It is also an arid district but the population here has access to good health care because of its proximity to Hyderabad.
Krishna district has the highest per capita income after the capital Hyderabad. It is an urban district where the population can afford health care.

This study was conducted in 2001. The survey was conducted in collaboration with the administrative head of each district, known as the District Collector or Magistrate, through a unique program called the 'Janmabhoomi Program'. During this program the government did a detailed health survey of each of the three districts Cuddapah, Medak and Krishna, where a medical questionnaire was filled in by each resident of the village/town. Cleft defects were included in the questionnaire in the form of one question which was 'do you know anyone in your village/neighbourhood that has a facial defect?'. If the answer was yes, then the local Primary Health Worker would identify the person with the cleft defect and investigate whether the cleft was a CL, CLP or CP. If the cleft was a CL or CLP then the side of the cleft would be noted. The parents' literacy and consanguinity would be noted.

Simultaneously, data was also collected through the District Medical and Health Officer (DMHO) and the District Education Officer (DEO). The DMHO obtained information of all clefts born or reported through primary health workers who are at primary health centers, which are established in every three villages and in every town. The DEO obtained the information through schools, which are established in every village and town. All the data recorded was entered into a database for further correlation.

The literacy rates of the parents were used as a marker because it is very difficult to obtain the exact per capita income of parents of children born with cleft defects living in rural areas, who depend on agriculture for their earnings. Agriculture in India is seasonal and yearly income fluctuates from year to year and therefore an accurate reading for income is not readily available. The literacy of a person was thought to correspond better to the socio-economic status of that person. Income from agriculture in India is exempt from income tax and people completely dependent on agriculture do not need to file the details of their income. This means that all government data on income in the rural areas of India are hypothetical and not exact.

Consanguinity is a widely practiced ritual in Andhra Pradesh. Marriages up to one degree of separation were taken to be a consanguineous relationship i.e. between a girl and her maternal uncle or the between the girl and her maternal uncle's son or her fraternal aunt's son. Therefore consanguinity was noted of the parents to establish a correlation between the two if any.

The age at the time of the survey and sex of the affected child were also noted. The age at the time of the survey was noted so that all children below 1 year of age could be counted towards the live births in the district for that year.

To estimate the prevalence of clefts based on gender, parents' literacy and consanguinity, background variables with a known distribution in the general population was needed. National census information for gender and literacy was available. To obtain the background variables for consanguinity a small cross-section study was undertaken (N=100) in each of the three districts.

RESULTS

The population, distance from Hyderabad and literacy rates of Andhra Pradesh and the three districts are given in Table 1.

| | Andhra Pradesh | Cuddapah District | Medak District | Krishna District |
|---|---|---|---|---|
| Population | 76,210,007 | 2,573,480 | 2,662,290 | 4,218,410 |
| Distance from Hyderabad (km) | | 300 | 50 | 250 |
| Literacy rate (%) | 61.11 | 64.02 | 53.24 | 69.91 |

*Table 1. Demographic information on state and district level*

The number of patients with cleft defects in the three districts were in Cuddapah 556, in Medak 490 and in Krishna 376. The age at the time of the survey and sex of the patients are given in Table 2. There was a male predominance for the cleft defects in all the districts under study. (Table 2)

| | Age at the time of survey | | | Sex | |
|---|---|---|---|---|---|
| | <1 year | 1-16 years | >16 years | Male (%) | Female (%) |
| Cuddapah District | 75 | 390 | 91 | 405 (73.1) | 151 (26.9) |
| Medak District | 57 | 345 | 88 | 313 (63.8) | 177 (36.2) |
| Krishna District | 71 | 241 | 64 | 218 (58.1) | 158 (42.5) |

*Table 2. Number, age and sex of patients with cleft defects in three districts of Andhra Pradesh*

Literacy rates of the parents of affected patients showed that the Krishna District statistically had the highest literacy rates as compared to the other districts (Table 3).

| | Consanguinity of parents | | Education levels of the parents | | | | |
|---|---|---|---|---|---|---|---|
| | Consan-guineous | Non-Consan-guineous | No Education (%) | Primary School (%) | High School (%) | Graduate (%) | Post Graduate (%) |
| Cuddapah District | 324 | 232 | 698 (76.7) | 171 (18.8) | 25 (2.8) | 14 (1.5) | 2 (0.2) |
| Medak District | 243 | 247 | 573 (63.5) | 262 (29.1) | 46 (5.1) | 18 (2.0) | 3 (0.3) |
| Krishna District | 155 | 221 | 292 (40.1) | 251 (34.5) | 151 (20.7) | 24 (3.3) | 10 (1.4) |

*Table 3. Consanguinity and education levels of parents with cleft affected offspring in three districts of Andhra Pradesh (number and percentage)*

With regard to consanguineous marriages Cuddapah had the highest percentage within the patient group compared to the other two districts (Table 3)

There was a high incidence of Cleft Lip and Palate (CLP) in all three districts followed by Cleft Lip (CL). The incidence of Isolated Cleft Palate was very low. (Table 4)

| | Cuddapah District (%) | Medak District (%) | Krishna District (%) |
|---|---|---|---|
| Isolated cleft lip | 167 (30) | 156 (32) | 139 (37) |
| Cleft lip and Palate | 368 (66) | 319 (65) | 226(60) |
| *Unilateral* | *422 (79)* | *370 (78)* | *292 (80)* |
| *Left* | *262 (62)* | *244 (66)* | *184 (63)* |
| *Right* | *160 (38)* | *126 (33)* | *108 (37)* |
| *Bilateral* | *113 (21)* | *105(22)* | *73 (20)* |
| Isolated cleft palate | 16 (3) | 12 (2) | 9 (2) |
| Craniofacial cleft | 5 (1) | 3 (1) | 2 (1) |

*Table 4. Type and side of cleft per district (number and percentage)*

There was a higher prevalence of unilateral clefts than of bilateral clefts. In unilateral clefts there was a higher prevalence of left sided clefts as compared to right sided ones (Table 4).

We calculated the prevalence of clefts in each district by registering the total number of live births in each district in 2001 and dividing it by the number of children who had clefts and were under 1 year in the same district. The prevalence for the state of Andhra Pradesh was calculated by defining the average of the prevalence of the three districts. The number of live births in Andhra Pradesh State during the same period was 1,666,000 (Census of India 2001). Assuming the prevalence in the state at 1.09 in 1000 live births, 1,830 children were born with cleft defects in the state of Andhra Pradesh in 2001 (Table 5).

| | Cuddapah District | Medak District | Krishna District | Andhra Pradesh State |
|---|---|---|---|---|
| Live Births | 65,562 | 49,504 | 69,741 | 184,807 |
| Cleft Defects | 75 | 57 | 71 | 203 |
| Incidence | 1.14 in 1000 live births | 1.15 in 1000 live births | 1.01 in 1000 live births | 1.09 in 1000 live births |

*Table 5. Incidence of clefts per district.*

The relation between prevalence of clefts and background variables was also calculated. For gender, the national census information shows that the ratio of males to females is 1000:993 (Census of India 2001). This information regards the national ratio as information on a district level is not available. For literacy rates, using an education level of primary school or higher as a definition of "literate", the percentages for the districts were Cuddapah 64.5%, Medak 53.2% and Krishna 69.9% (Census of India 2001). For consanguinity the prevalence in a small cross sectional study of 100 couples in each of the three districts was Cuddapah 21%, Medak 12% and Krishna 9%. To convert the percentages into absolute numbers for the background variables for gender and literacy it was arbitrarily chosen to be 1000.

The odds ratio for a child being born with a cleft in relation with gender is 2.50, 1.65 and 1.29 for the districts of Cuddapah, Medak and Krishna respectively. With regard to parents' illiteracy the odds ratio's are 5.85 for Cuddapah, 1.98 for Medak and 1.55 for Krishna. Consanguinity is 5.25, 7.21 and 7.09 for the three districts respectively. All 9 odds ratio's are statistically significantly above 1, as can be seen from the 95% confidence intervals (Table 6).

| | *Cuddapah District* | | *Medak District* | | *Krishna District* | |
|---|---|---|---|---|---|---|
| | Case | Ctrl | Case | Ctrl | Case | Ctrl |
| **Gender** | | | | | | |
| Male | 405 | 517 | 313 | 517 | 218 | 517 |
| Female | 151 | 483 | 177 | 483 | 158 | 483 |
| Odds Ratio | 2.50 | | 1.65 | | 1.29 | |
| 95% CI for OR | [1.99 - 15] | | [1.32 - 2.07] | | [1.01 - 1.64] | |
| **Literacy** | | | | | | |
| Yes | 698 | 360 | 573 | 468 | 291 | 301 |
| No | 212 | 640 | 329 | 532 | 437 | 699 |
| Odds Ratio | 5.85 | | 1.98 | | 1.55 | |
| 95% CI for OR | [4.77 - 7.18] | | [1.64 - 2.39] | | [1.26 - 1.90] | |
| **Consanguinity** | | | | | | |
| Yes | 232 | 790 | 247 | 880 | 221 | 910 |
| No | 324 | 210 | 243 | 120 | 155 | 90 |
| Odds Ratio | 5.25 | | 7.21 | | 7.09 | |
| 95% CI for OR | [4.17 - 6.62] | | [5.53 - 9.41] | | [5.23 - 9.62] | |

*Table 6. Relation between clefts and gender, literacy and consanguinity per district.*

DISCUSSION

This study was conducted in 2001. The reason for a delay in publishing these findings is that the study of prevalence of clefts was part of a much larger program. This program was a state wide development program where the Government of Andhra Pradesh was reaching out to 80 million people of the state. The districts involved with this study have a population in excess of 9.45 million. Since most of the data, including the data the Government of Andhra Pradesh was collecting, was being collected for the first time, sorting out and collating the data took time.

There are also some drawbacks to a study of this size. Firstly, the study had to be simplified such that very few questions had to be asked by the interviewers as other programs were being jointly run by the government. Secondly, the staff interviewing the subjects were not trained doctors and therefore could only be trained to identify a cleft and a detailed report on conditions that might have contributed to the cleft could not be included in the study.

While calculating the prevalence of cleft based on the data collected, it was agreed that those children that were less than one year of age would be included in the census as a simultaneous census to see the total number of live births in that region was concurrently going on. We do accept that there might be misrepresentation of children that might have died during the year. However, we accepted this method because registry for births and deaths is not very accurately maintained in large parts of rural areas of the state.

A review of studies for prevalence of cleft lip and palate shows that there is a particular trend in different parts of the world. A WHO study published as Global Strategies to Reduce the Health Care Burden of Craniofacial Anomalies in 2000 details the prevalence in 13 countries and the prevalence varies from 0.22 to 1.67 per 1000 live births[3].

Birth prevalence and incidence of oral-facial clefting show ethnic variation. It is generally thought that populations of Asian or Native North American descent have the highest prevalence, with Caucasian populations having intermediate prevalence and African populations having the lowest prevalence[6]. In studies conducted on Caucasian population, the prevalence of clefts in Northern Ireland was found to be 1.28 for every 1000 live birth[7]. The prevalence of cleft defects in Stockholm County in Sweden was found to be 2.0:1000 live birth[8]. In studies conducted in Latin American population, a study in Northeast Mexico showed a prevalence of clefts to be 1.1:1000 live birth[9], while a study carried out in an African population in Nigeria showed a birth rate of cleft anomalies at 0.4:1000 live birth[10].In Asia, a study of a Han Chinese population in Shanghai, China[11] showed a prevalence of 1.12 per 1000 live births. A study of a native Filipino population reported that the prevalence was higher at 1.54 in 1000 live births[12]. A study in Iran showed an prevalence of 1.03:1000 live birth[13]. Our study showed a prevalence of 1.09 in 1000 live births. In India meta-analysis of 25 early studies from 1960 to 1979 involving 407,025 births showed 440 births with CLP and 25 births with CP with a prevalence of 1.08 and 0.23 in 100 live births respectively[4].

Most studies, including ours, report a male predominance in the sex ratio in cleft lip and palate patients and a female predominance in patients with cleft palate defects only[14,15,16]. However one district in our study showed an unusually high male predominance for clefts. This discrepancy needs to be further investigated for any extraneous circumstances. Male predominance for cleft lip and palate was also confirmed by the odds ratio which determined that there was a greater possibility of a male child being born with a cleft lip and palate.

Most studies give a ratio between unilateral and bilateral cleft lips to be predominantly favouring unilateral cleft lips[15,17,18]. We found 79% of the cleft lip defects were unilateral in nature. It is also widely accepted that left sided unilateral

clefts are more common than right sided unilateral cleft lips[10,14] which is supported by this study. Of the unilateral cleft lips in our study 64% were left sided.

The type and extent of cleft defects vary according to race. In a study published on a Caucasian cleft population the prevalence of CL was 25%, CLP 50%, and 25%CP[19]. A study on an African cleft population, done in Nigeria, showed prevalence to be CL 49%, CLP 32% and 19% CP[10]. Our study showed a prevalence of CL to be 33%, CLP 64 %, and CP 3%. The reason for the low percentage of CP could be due to under reporting of the problem. CP may be undiagnosed at birth and could have been missed in the evaluation of patients.

As stated earlier consanguinity is a widely practiced ritual in Andhra Pradesh. Our study shows that consanguinity of parents is a major risk factor for cleft formation. This study highlights the regressive nature of this practice.

We found a significant differentiation in cleft birth rates between urban and rural areas which are in contrast with the Chinese study[16]. We found a strong correlation between illiteracy and clefts in our study. We also found that illiteracy rates were higher in rural areas in the state. We feel, and this was confirmed by the study, that poorer sections of society are more likely to be illiterate and the odds ratio of a cleft being born to illiterate parents is considerably higher. Additionally it should be noted that a relation between illiteracy and consanguinity is likely, with a higher percentages of consanguinity in illiterate populations. Therefore, a part of the relation between illiteracy and cleft birth rates might be due to confounding between illiteracy and consanguinity. Data to check this is currently not available. This implies that the relation between illiteracy and cleft birth rate needs further study to assess its true size and understand the biological mechanism.

## CONCLUSION

Our study showed a prevalence of 1.09 in 1000 live births, which was significantly less than the Caucasian and Filipino population studies and significantly higher than the African population study. It was however comparable to other Asian studies like those done in China, Iran and particularly India. It was also comparable to a study done in Mexico.

Three different districts of Andhra Pradesh were chosen to represent the state. This design could be used in other districts to accurately detect the prevalence of clefts.

Data sources may influence or bias the results. Thus precise documentations of birth and death registry will help to evaluate the true values of prevalence.

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# CHAPTER 3

# Developing and Standardizing a Center to Treat Cleft and Craniofacial Anomalies in a Developing Country like India

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ABSTRACT

The range of facial deformities is enormous. All produce some degree of disfigurement and result in the impairment of function to some degree, sometimes even to the point of incompatibility with life. Congenital facial defects in India are associated with considerable superstition, social rejection, and failure to integrate into society.

In India, cleft defects occur in 1 in 500 births. Congenital facial defects are a pressing problem in India owing to the limited resources to treat such patients. Poverty is a major factor for parents of such children to get appropriate treatment.

Setting up an institute to treat children with cleft and craniofacial deformities in India presents problems with financing treatment for poor patients, procuring the right infrastructure, and employing welltrained human resources.

The authors have set up such an institute in Hyderabad in the southern state of Andhra Pradesh in India. The logistics of setting up such a facility in a developing country and the future of funding for cleft treatment are important factors to consider while establishing a center for patients with cleft and craniofacial anomalies. The aim of setting up such centers was to provide quality comprehensive treatment for patients from all sections of society with cleft and craniofacial anomalies.

INTRODUCTION

The range of facial deformities is enormous. All produce some degree of disfigurement and result in the impairment of function to some degree, sometimes even to the point of incompatibility with life[1]. Congenital facial defects in India are associated with considerable superstition, social rejection and failure to integrate into society. In managing such defects the goals of the treatment include the management of the human psyche and the patient's acceptance to the society.

Approximately 15 children are born with clefts per hour worldwide. A child is born with a cleft somewhere in the world every 2 minutes[2]. In India, cleft lip/palate occurs in nearly 1 in 500 live births and most of these defects are not surgically corrected[3]. The congenital facial defects are a pressing problem in India owing to limited resources. The burden of care for the child with cleft affects the entire family units. It is not unusual to see patients with untreated cleft lip for the entirety of their life. The complete rehabilitation of these patients involves speech therapy and orthodontics, secondary corrections are inconsistent at best and often times unavailable.

India is the second most populated country in the world[4] with a population of 1,147,677,000. The annual per capita income of India as of February 28, 2008, is Indian Rupee 29,786 (US$ 660)[5]. Andhra Pradesh state, where the GSR Craniofacial Institute is situated, is located in the southern part of India. Andhra Pradesh[4] is spread over an area of 275,000 $km^2$ with a population of 81,315,000. The annual per capita income of Andhra Pradesh is Indian Rupee 33,970 (US$ 755)[6]. The state is divided into 23 administrative districts with Hyderabad city as its capital. Each district is further divided into mandals. There are 1123 mandals in the state, which are further divided into villages, towns and cities. There are 26,586 villages in the state. Any place that has more than 0.5 million residents is classified as a town and

has a municipal administration. Any town that has a population more than 1.5 million is classified as a city. There are 264 towns and cities in Andhra Pradesh.

Government-funded general hospitals are situated in every district capital. Sub units of general hospital are usually located in 2 or 3 large towns in the district and are known as area hospitals. Smaller referral primary health centers or community health centers are located on an average, 1 for every 3 villages. This system of health care delivery is government-funded, and the care provided is free of cost to the patient. These hospitals see more than 2 million patients as outpatients and more than 160,000 patients as inpatients[7]. The budget allocation for health care by the government of Andhra Pradesh for the financial year 2007 to 2008 was Indian Rupee 13,150 million (US$ 292 million)[6]. The per capita allocation of funds for health care is less than US$ 4 per person in the state. This also means that government hospitals are understaffed and have poor infrastructure.

The private or corporate hospitals are usually located in larger towns and cities. These hospitals have better facilities and cater to patients who can afford health insurance or can directly pay for the healthcare services. The average cost of each surgery for simple cleft defects at such hospitals will be between Indian Rupee 25,000 (US$ 500) and 50,000 (US$ 1,000).

With an annual per capita income of US$ 755, most people in the state cannot afford health insurance. Less than 10 % of the population has health insurance in Andhra Pradesh, India. Hence, access to care at these hospitals is limited to a minority of population.

HISTORY

The history of treatment of patients with cleft and craniofacial deformities in India started with Sir Benjamin Rank from the University of Melbourne coming to India in 1955 to train Indian surgeons in plastic surgery. Dr. C. Balakrishnan established[8] a major plastic surgical department at the Postgraduate Institute at Chandigarh in the 1950s. Dr. Behman Davar, Dr. Charles Pinto, Dr. Arthur De Sa, Dr. Rustom Irani developed[8] cleft centers in the 1960s. Since then, some dedicated surgeons as Dr. Adenwala in Trichur, Kerala, Drs. K. S. Goleria, Suresh Tambwekar and Ravin Thatte in Mumbai and many others around the country have been treating patients with cleft defects.

The cleft and craniofacial deformities are looked upon in India as cosmetic deformities rather than functional deformities by many treating physicians. The focus has been on the surgery of the soft tissue defect alone of the face, that is, cleft lip or nose and palate.

Total rehabilitation of the patient involves patient's education, genetic counseling, and speech management; secondary corrections are not considered by most physicians and cleft centers. These surgeons were unable to create teams that included the comprehensive management of the cleft and craniofacial defects. This is due to the large volume of patient populations, few well-trained personnel, and lack of financial resources.

This changed in the year 2000 when an American funding agency set up a base in India to fund cleft treatment. These funds helped surgeons treat patients who could not afford the care. This encouraged more surgeons to provide care and propagated additional funding agencies to participate in cleft management since 2001. However the local hospitals and surgeon did not have proper mechanisms in

place to make optimal use of the funding. This led to some hospitals and surgeon stop work, citing low returns on investment.

## OBJECTIVES AND PLAN

The primary author developed a basic plan to start a Cleft and Craniofacial Center in October 2000. The primary objective was to provide comprehensive care to patients with cleft and craniofacial defects, who cannot afford the costs of their treatment. The other objectives included patient recruitment and access to care, long term financial self-sustainability, standardized record keeping, delivery of multispecialty care and develop outcome studies from the gathered data.

Because most patients could not afford treatment, raising funds for treatment is the only option. To maximize the care with minimal resources, the treatment focus was on congenital facial deformities only. This was also conducive to build an administrative system for a hospital treating only 1 part of the body where employment of staff and costs can be kept to an essential minimum. In addition, the authors thought that this could be best established by an independent institute without bureaucratic hurdles that are faced in a developing country. Infrastructural and administrative expenses would be used solely for the work that is funded. The desired goal for the facility is to handle 1200 cleft and craniofacial surgeries with 500 cleft speech therapies and 200 cleft orthodontic therapies every year.

This facility would cater to the population of approximately 100 million people living in an area in a 1000-km radius from Hyderabad, which includes the adjacent districts and states. All employees and physicians served on a full-time basis. This improved efficiency. This was also a means to provide employment opportunities for the local population.

The Cleft and Craniofacial Institute is to be managed under 4 categories: treatment, infrastructure and equipment, human resources and research (Figure 1).


*Figure 1: Four headings under which funds are raised by the HCS.*

Funds are to be raised for each aspect separately even if 1 person or institution was funding multiple areas of care. The needs of the patient are to be addressed starting with transporting the patient from their district or mandal headquarter, delivering treatment in the form of surgery, orthodontics and speech therapy, providing free medicines and transporting the patient back to their districts.

Education and awareness of the parents and patients with cleft and facial deformities, treatment facilities and options available are by partnering individuals, nongovernment agencies and the local government bodies. In addition, the institute needs to aggressively procure the necessary infrastructure by donations and fund-raising from different resources.

The research is planned to be carried out by starting partnerships with various institutions around the world. The large volume of cleft and craniofacial surgeries, would help in providing the outcomes research. This would help in collaborating

with other universities and hospitals and develop various basic science and clinical science research projects.

## IMPLEMENTATION AND STANDARDIZATION

From August 1996 to September 2000, the primary author was the sole administrator and surgeon. He visited various districts on rotation twice a week to organize surgical treatment for patients with cleft and craniofacial disorders. This helped educate the various primary care physicians and also bring awareness about the cleft deformities and their management.

This experience helped the primary author realize the value of centralization to a single institute to provide comprehensive and cohesive care. The logical place to set up the institute was in Hyderabad, which is the capital of the state of Andhra Pradesh. This city is easily accessible to the surrounding states of Tamil Nadu, Karnataka, Maharashtra, Madhya Pradesh, and Orissa.

Setting up a complete stand-alone institution would initially have required large financial support. The primary author started this project in an existing hospital. He recruited other consultants and formed a team that included a pediatrician, an otolaryngologist, a neurosurgeon, a speech therapist, an orthodontist and a general dentist. A core group of nurses were trained in managing infants and children with facial defects.

In November 2000, with the entry of external funding agencies into India, the team shifted its base to a larger but lesser used hospital in June 2001. However, the primary author faced procedural and administrative hurdles, and the costs for providing similar care increased with no improvement in delivery of care. In November 2003, the authors decided that, to have a sustainable module for

organizing a center for cleft and craniofacial defects, a stand-alone institution is required. This is found to be the best option that would ensure optimal use of external funding.

The Hyderabad Cleft Society (HCS), which was established as a not-for-profit society in 1996, was now used as the instrument to raise funds. The HCS set up the GSR Institute of Craniofacial Surgery, a 50-bedded hospital, as its operating arm to deliver comprehensive treatment to patients with cleft and craniofacial defects.

Screening and awareness campaigns were launched statewide in all districts within and outside the state in a 1000-km radius of the hospital. At such campaigns, patients with congenital facial defects are screened for treatment at the institute. Patient's education and awareness are increased about consanguinity and its effects on birth of children with congenital defects and dispel superstitions such as clefts being associated with the eclipse of the sun and moon.

In India, children with cleft and craniofacial defects experience malnutrition. Approximately 42% to 57% of all child deaths in developing countries are due to the potentiating effects of malnutrition on infectious disease, of which more than three quarters can be attributed to mild to moderate malnutrition[9]. In India, 17% of children younger than 5 years are mild to moderately undernourished and 6% of children are severely malnourished[10]. In Andhra Pradesh, the figures are 11.4% and 3.8%, respectively. Children born with cleft and craniofacial defects are prone to higher malnutrition because of feeding problems associated with their defects. Feeding advice in the form of audiovisual tools is given to all parents of children with cleft and craniofacial defects, who bring their children for consultation.

The Institute has treated 13,835 patients as of November 30, 2008. These patients are provided transportation to the hospital, surgical care at appropriate times, and

other treatments such as orthodontics and speech therapy and transported back. Most care and transportation are provided free of cost. The fees paid by few patients who can afford go into the corpus of HCS.

The HCS continues to build a corpus from external and domestic funding agencies to ensure long-term sustenance. The HCS currently supports a team of 7 surgeons, 3 pediatricians, a geneticist, couple of speech therapists and orthodontists.

The Institute consists of 2 fully functional operating rooms, an intensive care unit with pediatric ventilators, radiographic machines, orthodontic/dental equipment, and speech therapy equipment. The infrastructure includes a 50-bed hospital facility that includes a 6-bed postoperative facility, a dental clinic and a speech therapy clinic. Most of the records are computerized; these include patient' photographs, staging of surgery, postoperative follow-up, and recall dates for long-term follow up. The long-term follow-up of patients has risen from a meager 8% in 2000 to 46% in 2008.

The authors run the charity as a nonprofit corporate entity, by maximizing the number of patients getting standard care, and continue to retain well-trained personnel. The numbers of patients treated by the Institute are mentioned in Figures 2 to 4.

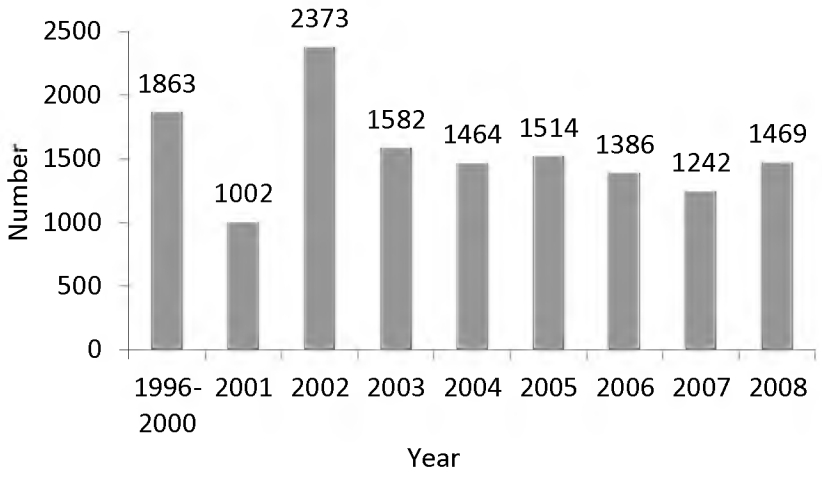


*Figure 2 Number of patients treated surgically at the GSR Institute of Craniofacial Surgery from 1996 to 2008.*

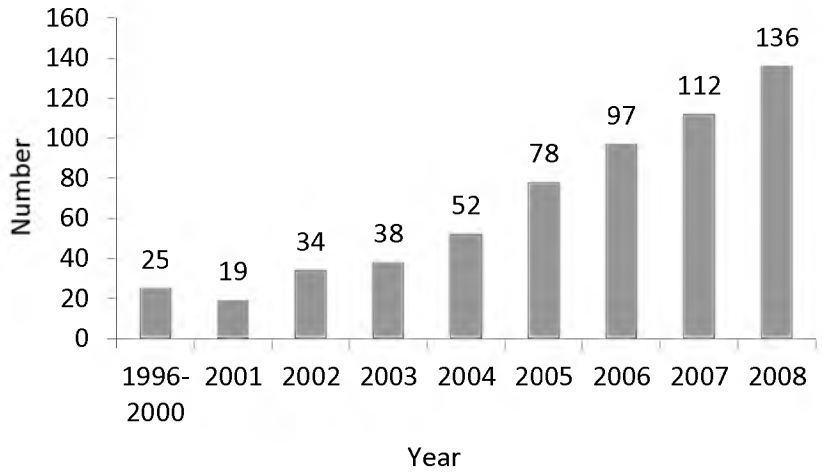


*Figure 3 Number of patients treated with orthodontics at the GSR Institute of Craniofacial Surgery from 1996 to 2008.*

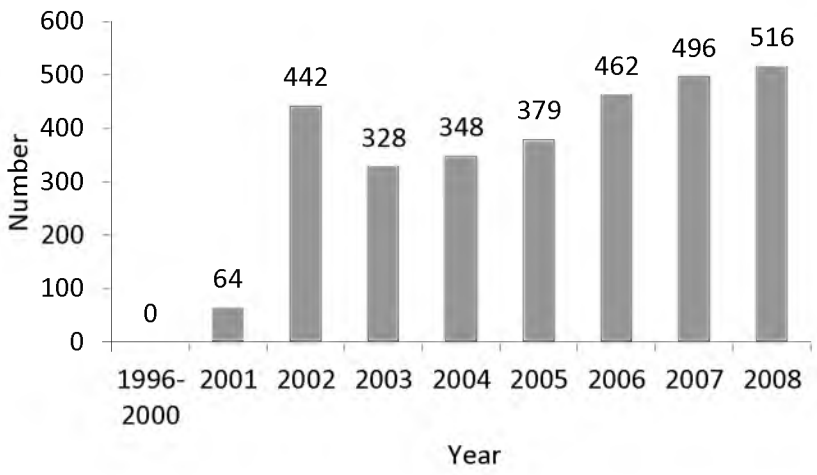


*Figure 4 Number of patients treated with speech therapy at the GSR Institute of Craniofacial Surgery from 1996 to 2008.*

For the past 8 years, the management of cleft and craniofacial deformities has changed. There is increasing importance given to speech therapy and orthodontics and secondary surgical corrections. The fund-raising is done by surgeons on behalf of all the departments involved. There is streamlining of the charity given and accepted by various institutions. The authors believe that the complete rehabilitation of a patient happens only with the total integration into society by appropriate education and self-sustainability. Currently, there is still poor acceptance of patients with facial deformities in India especially in rural areas. This is improving with education. Meanwhile, the HCS is facilitating in establishing a residential school to educate children with clefts so that they could seek meaningful employment.

The surgeons, institute, and other personnel are encouraged to interact and collaborate with organizations for their administrative and technical expertise. The GSR Institute of Craniofacial Surgery continues to forge partnerships with universities and funding organizations in countries such as Belgium, Canada,

Germany, Italy, the Netherlands, South Korea, Sweden, Switzerland, United States of America, United Kingdom and the Indian Subcontinent. This helps in constant improvement of the quality of work done at the institute. In addition, the regular exchange programs advance fund-raising capacities with strategic alliances with well-established funding agencies.

The financial quality control and management is conducted internally by nongovernment third-party audits and legally by the Ministry of Home, Government of India, under the Foreign Contributions Regulation Act 1976. The health outcomes of the medical and technical aspects of the institute is overseen by an international medical advisory board made up of health care professionals from all disciplines including surgery, orthodontics and speech therapy.

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# CHAPTER 4

# Congenital Anomalies Associated with Cleft Lip and Palate Defects in a High Volume Indian Centre

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ABSTRACT

Objective: The objective of this study was to find the prevalence of associated anomalies in patients with cleft lip and palate defects. A number of associated anomalies were noticed by the authors while routinely examining patients with cleft and craniofacial defects at their center. An accurate study to identify the prevalence of associated anomalies in cleft lip and palate patients was needed, to emphasize the need for a thorough investigation of children with cleft lip and palate and the need for a multidisciplinary team to diagnose cleft lip and palate. There was also a need to study the impact of associated anomalies on the burden of cleft care in a developing country like India.

Design and Setting: This is a retrospective study of 800 consecutive patients with cleft lip and palate CL=184, CLP=532, CP=84 seen in the year 2006. The data were collected by processing the case history of the patients. The patient's cleft defect, age and sex was noted along with the religious background, level of income and consanguinity. The anomalies were classified under 10 headings depending on the organ system affected.

Results: Associated anomalies were present in 330 cases (41.3%). The highest prevalence of 46.4% was found in patients with cleft lip and palate. The lowest prevalence of 27.7 % was found in isolated cleft lip patients. There was no significant difference of prevalence found between unilateral or bilateral clefts and complete or incomplete clefts. The skeletal system was affected the most. Anomalies of the skeletal system count for 42% of all anomalies. Logistic regression revealed that having an isolated cleft palate decreased the chance of having an associated anomaly being a Muslim or from another religion as compared to being a Hindu. Other background data did not have a statistically significant chance to have an associated anomaly with clefts.

Conclusion: There was a high prevalence of associated anomalies in the study done at this center. There was, however a need to study the reasons for such anomalies further. There is also a need to study the impact of such anomalies on the burden of cleft care in developing countries.

INTRODUCTION

Cleft lip with or without cleft palate (CLP, CL), and isolated cleft palate (CP), collectively termed as oral clefts (OC), are major human birth defects that represent a significant public health burden with a worldwide prevalence of 1 in every 500 to 1000 births [1,2]. Orofacial clefts occur in all races, in both sexes, and in all socioeconomic groups. Nevertheless, the reported rates of clefts, as well as the types of associated anomalies, vary considerably [3,4,5,6,7], and this variation is highly dependent on the methods of ascertainment [8]. In India the birth rate of clefts according to a study performed in 1994 showed a prevalence of CLP of 0.93 per 1000 and CP only of 0.17 per 1000 [9].

Preferential associations are nonrandom associations between two or more anomalies, and their detection is the first step to identify new patterns of birth defects[10]. In the past, several studies on the prevalence of associated anomalies were performed, but they had different results[3,4,5,6,]. Not only were the results on prevalence different, but there was also no consensus about which organ system was affected the most. Results on whether isolated cleft palate or cleft lip and palate patients have more anomalies are also inconsistent[3,5]. The different outcomes of previous studies resulted in this study to determine the prevalence of associated anomalies in the patient population at this Institute.

A retrospective study was performed in a high-volume centre for craniofacial surgery in India. The aims were (1) to identify preferential associations between three types of oral clefts (CL, CLP, and CP) and other anomalies in a large case series, (2) based on their association patterns, to emphasize the need for thorough investigation before the treatment, and (3) to know the common and different anomalies associated with these oral clefts.

## MATERIALS AND METHODS

The data for this retrospective study were obtained from medical records from a high-volume centre for cleft and craniofacial surgery located in Hyderabad, India. 800 consecutive patients with CL, CP and CLP, admitted for treatment in 2006, were included in this study (n=800).

The patient's cleft defect, age and sex was noted along with the religious background, level of income and consanguinity. The anomalies were classified under 10 headings depending on the organ system affected.

A pediatrician performed a general physical examination to ascertain associated anomalies. A standardized assessment form was used to record the data, which contained information on the type of cleft and information on associated anomalies. The anomalies were classified under ten groups according to the organ system affected. In case of any superficial anomalies, the primarily affected organ system was recorded. If there was any suspicion for an anomaly, which could not be defined by physical examination, these patients were sent to specific departments for further evaluation. If this further examination showed that there was an anomaly, the primarily affected organ system was also noted in the patient record. Anomalies of the central nervous system were only recorded if they were obviously apparent during physical examination.

SPSS 14.0 for Windows was used for statistical analysis. Comparisons between groups were made using independent samples-t-tests.

RESULTS

Of the 800 patients studied, the number of patients with isolated cleft lips (CL) was 184 (23.0%), the number of patients with isolated cleft palates (CP) was 84 (10.5%) and those with cleft lip and palates (CLP) were 532 (66.5%). Of the CL, 164 (89.1%) were unilateral and 20 (10.9%) were bilateral. Of the CLP 406 (76.3%) were unilateral and 126 (23.7%) were bilateral. 448 (56%) of the patients were male and 352 (44%) were female. 656 (82%) practiced the Hindu religion, 112 (14%) practised Islam, 28 (3.5%) practised Christianity and 4 (0.5%) practised Sikhism. 228 (28.5%) patients were children of a consanguineous marriage.

| 1. Skeletal system n = 189 | | | |
|---|---|---|---|
| Anomaly of the skull | 38 | Syndactily | 11 |
| Anomaly of the mandible | 35 | Retarded Growth | 11 |
| Anomaly of the limbs | 23 | Frontal Bossing | 10 |
| Polydactily | 15 | Microcephaly | 3 |
| Anomaly of the fingers or toes | 14 | Acrocephaly | 2 |
| Anomaly of the foot | 14 | Anomaly of the Zygomatic Complex | 4 |
| Anomaly of the hand | 13 | | |
| **2. Facial anomalies n = 73** | | | |
| Facial asymmetry | 34 | Exophylic growth of lower lip | 1 |
| Facial Cleft | 31 | Torus of palate | 5 |
| Lower Lip Pits | 3 | | |
| **3. Central nervous system (n = 44)** | | | |
| Mental Retardation | 32 | Myelomeningocele | 2 |
| Encephalocele | 3 | Spina Bifida | 3 |
| Hydrocephaly | 3 | | |

| 4. Ear (n = 37) | | | |
|---|---|---|---|
| Eartags | 21 | Hearing Loss | 1 |
| Microtia | 15 | Unspecified | 17 |
| **5. Eye (n = 37)** | | | |
| Strabismus | 9 | Exopthalmus | 5 |
| Coloboma | 10 | Microphtalmia | 3 |
| Corneal aberrations | 10 | | |
| **6. Cardiovascular system (n = 33)** | | | |
| Pulmonary stenosis | 9 | Ventricular septal defect | 11 |
| Tetralogy of Fallot | 5 | Atrial septal defect | 3 |
| Coarctation of aorta | 4 | | |
| **7. Skin (n = 14)** | | | |
| Skin Discoloration | 8 | Unspecified | 6 |
| **8. Urogenital system (n = 11)** | | | |
| Unilateral renal agenesia | 5 | Hypospadiasis | 6 |
| **9. Respiratory system (n = 10)** | | | |
| Choanal atresia | 5 | Laryngeal anomaly | 2 |
| Pulmonary agenesia | 2 | Nose anomaly | 1 |
| **10. Digestive system (n = 7)** | | | |
| Common mesentery | 2 | Duodenal atresia | 2 |
| Esophageal atresia | 2 | Umbilical Hernia | 1 |

*Table 1. Distributions of associated anomalies classified under each heading.*

A single anomaly was found in 239 patients (29.9%), two anomalies were found in 63 patients (7.9%), three anomalies were found in 23 patients (2.9%), four anomalies in 4 patients (0.5%), and there was one patient with five anomalies. Anomalies of the skeletal system accounted for 42% of all anomalies, which was the highest organ system involved. (Table 2).

| | Total | Isolated Cleft Lip | Isolated Cleft palate | Cleft Lip and Palate |
|---|---|---|---|---|
| Number of patients | 800 | 184 | 84 | 532 |
| % with associated anomaly | 41.3 | 27.7 | 38.1 | 46.4 |
| 95% Confidence Interval | 37.8-44.7 | 21.2-34.3 | 27.5-48.7 | 42.2-50.7 |

*Table 2. Prevalence of associated anomalies according to type of cleft*

Logistic regression was applied to analyze the relation of background factors and clinical presentations on the chance of having associated anomalies with clefts. In this logistic regression, model independent variables that were studied were: sex, income, presence of cleft lip, presence of cleft palate, being child of consanguineous marriage, and religion. The results of this analysis are to be found in table 3.

| | P value | OR | 95.0% C.I.for OR | |
|---|---|---|---|---|
| | | | Lower | Upper |
| Income (0= "<12000 INR", 1= ">12.000INR") | 0.327 | 1.163 | 0.860 | 1.572 |
| Consanguineous marriage (1=y, 0=n) | 0.464 | 1.129 | 0.816 | 1.564 |
| CL (1=y, 0=n) | 0.069 | 0.806 | 0.639 | 1.017 |
| CP (1=y, 0=n) | 0.001 | 0.722 | 0.598 | 0.873 |
| Religion | 0.001 | | | |
| Muslim compared to Hindu | 0.002 | 0.480 | 0.304 | 0.760 |
| Other (Christian or Sikh) compared to Hindu | 0.043 | 0.351 | 0.128 | 0.968 |
| Sex (1=m, 2=f) | 0.460 | 1.120 | 0.830 | 1.511 |

*Table 3. Analysis of relation between patients characteristics and the prevalence of associated anomalies.*

A statistical significant relation was found both between CP and associated anomalies and Religion and associated anomalies. Children with a CP have 27.8% (1-0.722) less chance of having associated anomalies (p=0.001). With regard to religion it was seen that being a Muslim as compared to Hindu gives a 52% lower chance on associated anomalies (p=0.002), while this reduction for "Other Religion" as compared to Hindu was found to be 64.9% (p=0.043). It should be noted that due to the multivariate analysis, these effects are to be seen as the "pure effects" and are corrected for the influence of other variables in the model.

## DISCUSSION

The main objective of this article was to present prevalence and baseline characteristics of cases with OCs and associated anomalies. At least 50 publications have reported prevalence rates of associated malformations ranging from 4.3% to 63.4% [11].

This study was done in a center that exclusively treats children with cleft and craniofacial defects. It is a tertiary referral center that gets its patients from a radius of 1000 kilometers around it. This study does not show the prevalence of clefts and associated anomalies in a given population but attempts to calculate the presence of associated anomalies in a given population of patients with cleft defects.

This study found a prevalence of 41.3% of associated anomalies in 800 cleft patients. This is a higher percentage than that found in other recent studies like Calzolari et al. who showed a prevalence of 29.2%[12], Sarkozi et al., 26.5 %[13] Stoll et al. 2000 36.5%[7], and Rustemeyer et al., 33%[14], but less than studies done by Shprintzen et al.[3], which showed an prevalence of 63.4% and Berge et al. 66%[15]. This impressive variety can be explained in several ways. Different definitions of what an anomaly is could be one of the causes. In the Milerad et al. study for example, anomalies were only included if treatment or follow-up was required[5].

The age of the OC-patient at the moment of investigation may also play a dominant role. This might explain the high prevalence outcome in this study, since the length of time after birth that cases were examined was rather late. Furthermore, it is even more likely that the high age at examination resulted in an underestimation of the actual prevalence. Druschel et al. pointed out that first-year-of-life mortality is relatively high in cleft patients with associated anomalies[16] and Bergé et al. described a high mortality rate of prenataly detected OC-fetuses with associated anomalies[15]. Since only the survivors were included in this study, the prevalence of associated anomalies in OCs may be even much higher. Secondly early clinical signs maybe very subtle, so one might reasonably miss them during the first year of life. On the other hand, due to variation in the timing of the development of abnormalities, detection may be restricted until the child is 4 or 5 years of age. For example, the pits in the van der Woude syndrome may not always develop early in life[11]. A final explanation for the wide variation in estimates of prevalence is the small sample sizes[11].

Wyszinski et al. summarized it very clearly by stating that prevalence of associated anomalies varies considerably because of differences in case definition and inclusion/exclusion criteria, length of time after birth that cases are examined, variability of clinical expression of associated anomalies, knowledge and technology available to produce syndrome delineation, selection of patients, sources of ascertainment and sample size, true population differences and changes in frequency over time[11].

All the above mentioned reasons make it difficult to compare this study outcome to previous ones. The clinical and technical facilities to detect an anomaly were limited at this center. Patients were only referred to a specialized department for further investigation if there were any suspicions for an anomaly during physical examination. No standardized neurological investigation was performed, so major underestimation of CNS anomalies is probable. There was also no technology

available to detect syndromes by genetic investigation due to lack of facilities at the center.

The highest rates of consanguineous marriage have consistently been associated with low socioeconomic status, illiteracy, and rural residence[17,18,19]. The poor socioeconomic and environmental situation of most patients can be a plausible cause of the high prevalence of anomalies. But there seems to be a genetic component as well, because of the significant difference between Hindus and Muslims. Consanguinity has been reported as an important factor in the appearance of autosomal recessive diseases and congenital anomalies, including hydrocephalus, postaxial hand polydactyly, and CL±P[20,21]. This might also have been one of the reasons for the high prevalence of anomalies in our study. The distribution of subjects in this study is 82% and 14% of Hindus and Muslims respectively which corresponds to national distribution of 80.5% and 13.4% respectively[22].

In the present study, the skeletal system was affected most frequently which supports information from previous studies[3,4,7,12,13] that stated that the face and neck area was affected most frequently. The data from this study support this as well. A study done by Lilius in Scandinavia showed that most anomalies occur on the extremities, which was not the case in our study[4]. Stoll et al. and Rustemeyer et al. reported that central nervous system anomalies were very common[7,14] . Although central nervous system anomalies were also commonly present in our study, the number is probably an underestimation. Many CNS anomalies require MRI or CT scaning in order to be able to detect them, but unfortunately, this tool was not available.

This study found a lower prevalence of anomalies in CP patients (without cleft lip), but the results were not significant and the low prevalence can be caused by the low number of CP patients (n = 84). This study found a significantly lower prevalence for CL patients. This supports previous studies like Calzolari et al.; Stoll et al.; and Milerad et al.[5,7,12]. Harville et al. concluded that although CL±P cases

might represent the same condition, simply differing in severity, they showed some qualitative differences, such as male predominance for CL±P, and higher twinning and consanguinity rates for CL[23]. They should therefore be analyzed separately. Similarly, CL and CLP cannot easily be considered as distinct entities[10]. The fact that CLP shows more positive associations with other defects than CL could be indicating that infants with CLP are more severely affected during prenatal development than infants with only CL, as was noted in our study where 46.4% of patients with CLP were associated with more anomalies than isolated CL or CP patients. Croen et al., Stoll et al. and Rustemeyer et al. stated that patients with isolated cleft palate were more frequently affected than patients with cleft lip and palate[6,7,14], but Milerad et al. reported the opposite[5].

Although the cardiovascular system was frequently affected, the number of missed anomalies due to the lack of echocardiography investigations is probably high in our study. The actual number of anomalies in the digestive and urogenital systems is also probably higher than the number we found, due to limited means of investigation and limited sample size.

The center that performed this study was is located in India, which is a developing country with limited resources to treat cleft patients. To study the prevalence of associated anomalies, due to budgetary restraints, only those patients that were found to have an associated anomaly after thorough physical examination were referred to the specialized department to deal with that anomaly. Though a diagnosis could be made for 330 patients with other anomalies, only 119 (36%) could be treated for the associated anomaly either simultaneously with the cleft surgery or were treated separately. The center had to defer cleft surgery for 28 patients (8.5%) since there was no funding to treat the other anomalies before treating the cleft. To diagnose an associated anomaly for cleft patients the center had to absorb the increased expenses for each patient's diagnostic and specialized referral costs, as the patients visiting this center come from a low socio-economic background.

The burden of care, just to diagnose patients with associated anomalies, increased exponentially. Therefore some associated anomalies, though present during physical examination, were not thoroughly examined to reach a logical diagnosis and conclusion. The treatment of associated anomalies would increase the burden of care significantly.

The presence of associated anomalies with cleft defects in a patient raises the demand for additional care and will give rise to additional expectations from the patients themselves. The system of healthcare solutions for these patients has to focus on the entire patient in each case and not just the cleft defect alone.

This area of discussion should be investigated further to propose a plan to treat the patient instead of the cleft defect alone.

## CONCLUSION

There is a high prevalence of associated anomalies (41.3%) in this study group of cleft patients.

A routine screening for other malformations, especially skeletal, central nervous system, and cardiac defects, may need to be considered in infants with clefts. Close cooperation between several specialists and the pediatrician is of importance to comprehensively cover all aspects of these often complicated cases, before any surgery is undertaken. With such a high prevalence of associated anomalies in the cleft lip and palate patients, the need for a team to include a cardiologist, geneticist, neurologist and orthopedic surgeon increases.

There is also a need to treat each child with an associated anomaly and the cleft defect. In a developing country like India this increases the burden to treat children with cleft defects exponentially. There is therefore an urgent need to implement new protocols and treatment goals for children born with clefts.

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# CHAPTER 5

# Health related Quality of Life of Patients with Non-syndromic Orofacial Clefts

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ABSTRACT

Objective: To evaluate the relation between health-related quality of life (QOL), and patient characteristics in a large representative group of adolescents with non-syndromic orofacial clefts.

Study design: 724 non-syndromic patients with an orofacial cleft who had finished their surgical treatment were included in this prospective study. Mean age of the patients was 16.8 years (SD=1.9). Patients were divided into two groups: Cleft lip (CL), and Cleft lip and palate (CLP). The CL and CLP group was again divided into patients with unilateral and bilateral cleft lips. Health related quality of life was measured using a modified SF-36 questionnaire to measure eight dimensions namely, physical functioning, role limitations due to physical health, bodily pain, general health, vitality, social functioning, role limitations due to emotional health, and mental health with a five point Likert scale to assess the physical and mental components of patients with cleft defects.

To validate the modified SF-36 questionnaire, a control group of 744 patients who had undergone ENT surgeries were given the same questionnaire. The mean age of the control group was 17.3 years (SD=2.2).

Results: For all questions of the modified SF-36, the answers of the Control patients were compared with the answers of the Cleft patients, using the Chi-Square test. Except for 3 questions in the questionnaire there was a statistical difference in the answering pattern between the cleft and control group. All differences were found to be in the direction expected. Cleft patients showed a high score on the eight dimensions of the questionnaire. For five of the dimensions the mean score was above 4. The lowest score was found on bodily pain (mean 3.45). There was no effect of age. Having a cleft palate influenced all eight dimensions statistically more in a negative way than a cleft lip does. For social functioning boys scored 1% lower as compared to girls. Patients with a bilateral cleft had a statistically better score on physical functioning (+0.5%), vitality (+0.9%) and role limitations due to emotional health (+2%) when compared to unilateral clefts.

Conclusion: On average cleft patients have a good health related quality of life. However, there were differences in the levels of satisfaction. The major factor influencing quality of life negatively was the presence of a cleft palate.

## BACKGROUND

The World Health Organization (WHO) defines health as not only the absence of disease but also as the presence of factors that enhance physical, mental and social well-being[1]. This has led to a broader conceptualization of overall health in a way that quality of life plays an essential role in this WHO-well-being concept. As a consequence, successful outcome of medical treatment is not solely defined in terms of cure, repair or remission anymore, but is also extended to the maintenance or improvement of patients' quality of life after treatment. In this context, quality of life can be defined as a subjective well-being that reflects the difference between the hopes and expectations of a person and their present experience[2]. This is certainly true for children with chronic health conditions or conditions that require long-term treatment protocols, such as children with craniofacial abnormalities[1].

The face is a very sensitive region of the body[3]; It is what gives recognition to an individual. Therefore it is not surprising that facial esthetics are a very important aspect of an individual's general perception of life, especially between the ages of 18 and 30 years[4]. As a consequence, acquired (e.g. trauma, tumor) or congenital (e.g. orofacial clefts) facial deformities may influence quality of live in many different ways. Therefore, the treatment of cleft lip and palate deformities should not only provide good functional (e.g. speech, growth, occlusion) but also optimal esthetic results[5,6].

Judging functional and esthetic outcomes of cleft surgery has traditionally be performed by clinicians (surgeons, speech therapists, orthodontists)[7]. There are very few studies that elicit from patients how they feel after cleft therapy and how they assess their quality of life themselves[7]. One of the most successful methods of judging the over all treatment outcomes, is by measuring patient's satisfaction as well as by documenting the verdict of independent experts and laymen [8].

The purpose of this study is to evaluate the relation between health-related quality of life (QOL), and patient characteristics in a large representative group of adolescents with non-syndromic orofacial clefts.

## MATERIALS AND METHODS

### *Patients*

This was a cross-sectional study carried out in cleft patients at the Craniofacial Institute in Hyderabad (India) and otolaryngeal patients in the ENT institute in Hyderabad (India).

### *Cleft Patients*

All patients in the age group of 14 – 20 years (N=1012) that reported to the consultation area in the period between January 1, 2005 and December 31, 2005 and who fulfilled the inclusion criteria were asked to participate in the study. Only non-syndromic cleft patients with a definitive completed cleft treatment were included in the study. Also patients who were partly operated in other centers were included if they satisfied the inclusion criteria. Of the 1012 patients included in the study 724 patients filled the questionnaire.

Patients were divided into two groups: cleft lip only (CL) and cleft lip and palate (CLP). The patients who had a cleft lip, either with or without cleft palate were further divided into patients with a unilateral or a bilateral cleft lip.

### *ENT Patients*

A control group of patients (N=1132) within the same age group, who had undergone ENT surgery were included in the study. This was done to validate the efficacy of modifications in the questionnaire. 744 patients filled the questionnaire.

The research project was approved by the local Ethical Committee based on the guidelines declared by the Government of India. All participants were informed verbally on the study and signed a written informed consent.

*Methods*

Health related quality of life was measured with a modified Short Form-36 Health Survey (SF-36) questionnaire[9] using 5-point Likert scales[10.] The SF-36 is a generic instrument, which contains 36 items and measures eight domains of health: physical functioning, role limitations due to physical health, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional health, and mental health[9]. The Likert scales ranged from 1 to 5 with a higher value indicating a better perceived health.

Each patient that fulfilled the inclusion criteria and consented to participate in the study was interviewed based on the SF-36 questionnaire as given in Table 1. All the questionnaires were filled by a single counselor, previously trained in the use of the SF-36, based on the answers given by the patients.

*Statistical analysis*

For all questions of the modified SF-36, the answers of the Control patients were compared with the answers of the Cleft patients, using the Chi-Square test. To assess validity of the questionnaire, the direction of differences between the patient groups were scrutinized.

For the cleft group descriptive statistics, mean, standard deviation and range were computed for all eight dimensions. Furthermore, Pearson correlations between each combination on the overall scores in the eight dimensions were calculated to assess the coherence between the dimensions (e.g. correlations for physical and mental components were determined).

Linear regression was applied for each dimension to assess the relation between the mean score for that dimension and the following patient characteristics:

gender, cleft of hard and soft palate (yes or no), age and type of cleft (uni- or bilateral). Since the scores were asymmetric, they were transformed using the natural logarithm to achieve symmetry.

RESULTS

Out of a total of 1012 eligible cleft patients, 724 patients filled in the questionnaire (response rate 71.5%) and of a total of 1132 ENT patients, 744 filled the questionnaire (response rate 65.7%).

The answers of the cleft patients were compared to those of the ENT patients using the Chi-Square test. In Table 2 the distributions of the answers and the p-values are given. For the sake of brevity the percentages of the answers "1" and "2, which were given infrequently, are combined. It can be seen that with exception of the questions 3b, 3d and 3e the cleft patients show a distinctly different answering pattern in comparisons with the Control patients.

As can be seen in the column Direction, the difference in the questions 1, 2, 3a, 3c, 4d, 6, 7 and 8 show to cleft population giving answers indicating less complaints/more happiness, while the questions 3f through 3j, 4 (excluding 4d), 5, 10 and 11 show the Control patients to be more satisfied.

For all 33 differences found, the direction of the difference was found to be the direction expected. In the comparison Q 4d seems to stand out as the only question in the role of Physical Function dimension with a positive direction, while the others have an opposite direction. That is explained by the fact that the activities in Q 4a, 4b and 4c all imply meeting other people in which case cleft patients are aware of their facial features, while in Q 4d (riding car/two wheeler/bike) the treated cleft patient explains the positive difference with the control patients. activity is done alone. Therefore, the positive feeling of a treated cleft patient explains the positive difference with the control patients.

The fact that the modified SF-36 was sensitive enough to differentiate between control and cleft patients and the differences seen were all found to be logical, leads to the conclusion that this modified SF-36 is a useful instrument to measure the quality of life for oro facial patients.

The sample distribution of the cleft patients is given in Table 3. The mean age was 16.8 ± 1.9 years. Mean scores for each dimension are presented in Table 4. The mean correlation for the 28 combinations of dimensions is 0.849. Physical Functioning shows a relatively low correlation with Bodily Pain (0.663), General Health (0.692) and Social Function (0.669). All other correlations range from 0.707 to 0.942. All the correlations indicate a high level of coherence between the dimensions of the questionnaire.

The regression analyses for all eight dimensions of the results are given in Table 5.

For each combination of patient characteristics two numbers are given: the p-value, indicating statistical significance, as well as the estimated effect. For example, the estimate for the effect of having a cleft palate on Bodily Pain has a p-value of <0.001 indicating a very strong statistical significance. The effect is denoted to be -33%. This should be interpreted as indicating that, all other things being equal, having a cleft palate reduces the score on the Bodily Pain dimension by 33% as compared to those without a cleft palate.

The results show that age has no effect on the scores on all eight dimensions. Having a cleft palate has a statistically significant effect on all eight dimensions, showing a lower score on all eight dimensions. This effect decreases the score in the range of 5.8% and 37.7%. A statistically significant effect was found in the Social Functioning dimension for gender where the males scored 1% lower when compared to females. When comparing the type of clefts (unilateral and bilateral) the patients with bilateral clefts had a statistically better score in three dimensions: Physical functioning (+0.5%), Vitality (+0.9%) and Role Emotional (+2%).

| SCORE | | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|
| 1 | In general would you say your health is? | Very good | Good | Fair | Poor | Very poor |
| 2 | Compared to your general health before the operation what would you say your general health is now? | Much better | Little better | Same | Little worse | Much worse |
| 3 | Compared to your physical condition before the surgery, are you limited from doing the following after the surgery? | | | | | |
| 3a | Participating in vigorous activity such as strenuous sports etc. | Never | Seldom | Sometimes | Often | Always |
| 3b | Doing moderate activities such as moving chair or table | Never | Seldom | Sometimes | Often | Always |
| 3c | Doing simple activities like washing you face etc. | Never | Seldom | Sometimes | Often | Always |
| 3d | Lifting your eyebrows | Never | Seldom | Sometimes | Often | Always |
| 3e | Tightly closing your eyes | Never | Seldom | Sometimes | Often | Always |
| 3f | Opening your mouth | Never | Seldom | Sometimes | Often | Always |
| 3g | Blowing up your cheeks | Never | Seldom | Sometimes | Often | Always |
| 3h | Pursing your lips | Never | Seldom | Sometimes | Often | Always |
| 3i | Smiling | Never | Seldom | Sometimes | Often | Always |
| 3j | Blowing your nose | Never | Seldom | Sometimes | Often | Always |
| 4 | After your operation have you had to change any of the following routines because of your physical health? | | | | | |
| 4a | Going to work, school, college etc. | Never | Seldom | Sometimes | Often | Always |
| 4b | Playing outdoor sports | Never | Seldom | Sometimes | Often | Always |
| 4c | Staying outside your house for a period of time | Never | Seldom | Sometimes | Often | Always |
| 4d | Driving a car/Riding a two wheeler/Riding a bike | Never | Seldom | Sometimes | Often | Always |
| 5 | After your operation have you had to change any of the following routines because of your emotional state? | | | | | |
| 5a | Going to work, school, college etc. | Never | Seldom | Sometimes | Often | Always |
| 5b | Accomplished goals at work, school college etc. | Never | Seldom | Sometimes | Often | Always |
| 5c | Doing other work (like house hold chores etc.) | Never | Seldom | Sometimes | Often | Always |

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | Compared to your physical and emotional condition before and after the surgery, have your interactions with your friends, peers, family become. | Much better | Little better | Same | Little worse | Much worse |
| 7 | How much physical pain have you endured during the post operative period | None | Very little | Little | Bad | Very bad |
| 8 | How much did post operative pain interfere with your normal work (both outside and at home) | Never | Sometimes | Moderately | Most times | Always |
| 9 | How do you feel about the following after your operation? | | | | | |
| 9a | Do you feel happy with your life? | Always | Most times | Same | Sometimes | Never |
| 9b | Do you feel nervous of the future? | Never | Sometimes | Same | Most times | Always |
| 9c | Do you feel that nothing can cheer you up? | Never | Sometimes | Same | Most times | Always |
| 9d | Do you feel calm and peaceful? | Always | Most times | Same | Sometimes | Never |
| 9e | Do you feel that you have lots of energy? | Always | Most times | Same | Sometimes | Never |
| 9f | Do you feel disheartened? | Never | Sometimes | Same | Most times | Always |
| 9g | Do you feel burnt out? | Never | Sometimes | Same | Most times | Always |
| 9h | Do you think you are a happy person? | Always | Most times | Same | Sometimes | Never |
| 9i | Do you feel tired during the day? | Never | Sometimes | Same | Most times | Always |
| 10 | How much did your emotional status interfere with your normal work (both outside and at home) | Never | Sometimes | Moderately | Most times | Always |
| 11 | How true or false are the following statements | | | | | |
| 11a | I feel good about the way I look | Always true | Mostly true | Don't know | Mostly false | Always false |
| 11b | I feel good about the way I speak | Always true | Mostly true | Don't know | Mostly false | Always false |
| 11c | I feel good about my teeth and the way I chew food | Always true | Mostly true | Don't know | Mostly false | Always false |
| 11d | I want to improve the way I look, speak and/or chew my food | Always false | Mostly false | Don't know | Mostly true | Always true |

*Table 1. Modified Quality of life SF 36 Questionnaire*

| Answering categories | | | | | | |
|---|---|---|---|---|---|---|
| Question | *1+2* | *3* | *4* | *5* | P | Direction |
| Q 1 | 0.7/0.4 | 2.8/7.5 | 61.7/81 | 34.8/11 | <0.001 | + |
| Q 2 | 0.3/0.7 | 2.8/33.1 | 81.3/54.2 | 15.6/12.1 | <0.001 | + |
| Q 3a | 0.1/0.9 | 1.5/9.0 | 11.6/29.8 | 86.8/60.2 | <0.001 | + |
| Q 3b | 0.1/0.0 | 0.7/0.8 | 8.7/11.7 | 90.5/87.5 | 0.326 | |
| Q 3c | 0.1/0.0 | 0.4/0.0 | 7.8/13.8 | 91.7/86.2 | 0.001 | + |
| Q 3d | 0.1/0.0 | 0.0/0.0 | 4.6/6.7 | 95.3/93.3 | 0.379 | |
| Q 3e | 0.1/0.0 | 0.0/0.0 | 6.3/5.0 | 93.5/95 | 0.685 | |
| Q 3f | 0.1/0.0 | 3.5/0.3 | 69.5/11 | 26.9/88.7 | <0.001 | - |
| Q 3g | 0.1/0.0 | 10.9/0.0 | 80.1/9.1 | 8.9/90.9 | <0.001 | - |
| Q 3h | 0.1/0.0 | 5.1/0.0 | 87.0/7.1 | 7.8/92.9 | <0.001 | - |
| Q 3i | 0.3/0.0 | 4.6/0.0 | 66.4/7.3 | 28.8/92.7 | <0.001 | - |
| Q 3j | 0.3/1.1 | 12.2/4.6 | 84.8/52.3 | 2.7/42.1 | <0.001 | - |
| Q 4a | 0.0/1.1 | 9.8/9.5 | 59.5/14.2 | 30.6/75.1 | <0.001 | - |
| Q 4b | 0.0/2.6 | 7.0/9.3 | 60.6/45.2 | 32.4/43.0 | <0.001 | - |
| Q 4c | 0.0/0.0 | 6.9/2.3 | 59.5/20.3 | 33.6/77.4 | <0.001 | - |
| Q 4d | 0.0/0.0 | 1.5/3.1 | 9.4/44.5 | 89.1/52.4 | <0.001 | + |
| Q 5a | 0.0/0.0 | 7.0/2.7 | 62.8/13.7 | 30.2/83.6 | <0.001 | - |
| Q 5b | 0.0/0.0 | 7.0/3.8 | 61.3/12.4 | 31.7/83.9 | <0.001 | - |
| Q 5c | 0.4/0.0 | 6.6/3.1 | 62.1/10.6 | 30.9/86.3 | <0.001 | - |
| Q 6 | 0.0/0.7 | 7.1/88.3 | 61.3/10.5 | 31.6/0.5 | <0.001 | + |
| Q 7 | 4.6/6.3 | 63.7/88.7 | 31.3/5.0 | 0.4/0.0 | <0.001 | + |
| Q 8 | 4.0/1.7 | 59.8/43.8 | 5.2/41.5 | 30.9/12.9 | <0.001 | + |
| Q 9a | 0.3/0.1 | 5.2/6.7 | 63.7/84.4 | 30.8/8.7 | <0.001 | + |
| Q 9b | 0.0/0.0 | 8.2/9.7 | 59.8/83.9 | 32.0/6.5 | <0.001 | + |
| Q 9c | 0.0/0.0 | 4.2/8.6 | 64.1/85.1 | 31.7/6.3 | <0.001 | + |
| Q 9d | 0.0/0.0 | 6.6/11.2 | 63.2/83.2 | 30.2/5.6 | <0.001 | + |
| Q 9e | 0.0/0.0 | 7.5/9.8 | 61.3/82.9 | 31.2/7.3 | <0.001 | + |
| Q 9f | 0.0/0.0 | 10.6/12.5 | 57.8/81.6 | 31.6/5.9 | <0.001 | + |
| Q 9g | 0.0/0.0 | 7.8/10.9 | 60.6/81.2 | 31.6/7.9 | <0.001 | + |
| Q 9h | 0.0/0.0 | 9.4/10.1 | 58.7/83.1 | 31.9/6.9 | <0.001 | + |
| Q 9i | 0.0/0.0 | 6.0/9.5 | 61.7/81.3 | 32.3/9.1 | <0.001 | + |
| Q 10 | 5.2/0.1 | 58.3/3.4 | 5.0/52.8 | 31.5/43.7 | <0.001 | - |
| Q 11a | 3.9/0.0 | 59.7/3.0 | 4.4/73.8 | 32.0/23.3 | <0.001 | - |
| Q 11b | 4.2/0.0 | 59.4/2.3 | 3.9/74.6 | 32.5/23.1 | <0.001 | - |
| Q 11c | 4.0/0.0 | 59.3/3.1 | 4.6/72.7 | 32.1/24.2 | <0.001 | - |
| Q 11d | 64.5/2.3 | 4.2/10.3 | 31.3/75.8 | 0.0/11.6 | <0.001 | - |

*Table 2 Comparison of SF-36 answers by cleft and control patients. Percentage of answers given by Cleft patients are mentioned first. Direction is labelled "+" if Cleft patients show less complaints/more happiness and "–" if Control patients do so.*

| n = 724 | Male | Female |
|---|---|---|
| Unilateral cleft lip only | 143 | 80 |
| Bilateral cleft lip only | 19 | 13 |
| Unilateral cleft lip and palate | 175 | 160 |
| Bilateral cleft lip and palate | 95 | 39 |
| Total number of patients | 432 | 292 |

*Table 3 Sample distribution of the respondents*

| | Mean | Std. Deviation | Minimum | Maximum |
|---|---|---|---|---|
| Physical functioning | 4.49 | 0.18 | 3.9 | 4.9 |
| Role limitations due to physical health | 4.40 | 0.40 | 3.5 | 5.0 |
| Bodily pain | 3.45 | 0.72 | 2.0 | 5.0 |
| General health perceptions | 4.23 | 0.45 | 3.4 | 5.0 |
| Vitality | 4.24 | 0.50 | 3.0 | 5.0 |
| Social Functioning | 3.93 | 0.76 | 2.5 | 5.0 |
| Role limitations due to emotional health | 4.24 | 0.50 | 3.0 | 5.0 |
| Mental health | 3.56 | 0.85 | 2.4 | 4.8 |

*Table 4 Mean scores (1-5), standard deviation and range per dimension.*
*A higher score indicates better perceived health.*

| *Dimensions* | Gender | | Type Cleft | | Age | | Type | |
|---|---|---|---|---|---|---|---|---|
| | *0=f, 1=m* | | *0=lip only, 1=cleft palate* | | | | *1=uni, 2=bi* | |
| | effect | p | effect | p | effect | p | effect | p |
| Physical Functioning | 0.2% | 0.284 | -5.8% | <0.001 | 0.0% | 0.270 | 0.5% | 0.022 |
| Role limitations due to physical health | -0.3% | 0.210 | -15.6% | <0.001 | 0.1% | 0.130 | -0.6% | 0.092 |
| Bodily pain | 0.3% | 0.577 | -33.0% | <0.001 | -0.1% | 0.464 | 1.0% | 0.093 |
| General health | 0.4% | 0.074 | -18.9% | <0.001 | 0.0% | 0.938 | 0.1% | 0.609 |
| Vitality | 0.2% | 0.483 | -20.4% | <0.001 | 0.0% | 0.738 | 0.9% | 0.007 |
| Social Functioning | -1.0% | 0.048 | -31.2% | <0.001 | 0.1% | 0.482 | 1.0% | 0.090 |
| Role limitations due to emotional health | -0.4% | 0.200 | -20.5% | <0.001 | 0.0% | 0.867 | 2.0% | 0.000 |
| Mental health | -0.1% | 0.802 | -37.7% | <0.001 | 0.0% | 0.665 | -0.1% | 0.795 |

*Table 5 Results of a regression analysis. Relation between patient characteristics and dimensions of the questionnaire*

## DISCUSSION

Quality of life involves the normal societal environment of a human and constantly being influenced by it. When an individual is accepted in society, good quality of life or a sense of well being is more easily achieved. However it is very surprising to note that only 20% of cleft teams worldwide carry out a psychological assessment for their patients[7]. As a consequence it is likely that the prevalence of psychological problems is higher than the literature suggests[7]. Family dynamics, educational and vocational factors influence social development and rehabilitation of cleft lip palate patients. Psychological problems, such as lowered self esteem and difficulties during social interaction, are also experienced by a cleft lip palate individual [7]. Speech is also an important factor as a study in the Netherlands showed that a better psychosocial health was associated with fewer speech problems but not with a more or less abnormal facial appearance[11].

Quality of life studies in individuals with CL±P is not simple. The treatment for cleft defects starts from birth and continues well into adulthood. Patients with cleft defects do not have a say in who treats them or where they are treated. These decisions are usually taken by the parents and that is inter alia where the problem lies. This study was performed on data of patients who entered our clinic chronologically during one year. The male/female ratio was 1.5/1, which points to an overrepresentation of females as the expected male/female ratio in patients with clefts is 2/1. This is due to the fact that more women answered the questionnaire as compared to men.

In this study a modified SF-36 form was considered to be a good method to record the health related quality of life. The SF-36 is a multi-purpose, short-form health survey with only 36 questions and is the most widely evaluated generic patient assessed health outcome measure in a bibliographic study of the growth of "quality of life" measures[12]. It analyses both physical and mental/emotional components of a defined problem. The SF-36 is used to explore the internal consistency and validity in a cleft individual under study[7]. The SF-36 can be self administered, computer administered, or given by a trained interviewer in person or by telephone to persons ages 14 and older[9]. In this study the SF-36 form was modified to suit the study on cleft defects, keeping in mind the specific nature of complaints of patients with cleft defects. In the questionnaire the same eight dimensions as in the SF-36 are present: physical functioning, role limitations due to physical health, bodily pain, general health, vitality, social functioning, role limitations due to emotional health, and mental health. The questions to test these dimensions were modified to elicit compatible responses to cleft defects. In this study a five point Likert scale was used varying between the worst and the best response. Another method used to measure responses is the visual analog scale (VAS) which uses a 100 mm line to be marked off by the responders depending on their feelings[13]. The Likert scale was preferred to the VAS because most patients who answered the questionnaire were illiterate and they preferred the Likert scale to the VAS.

According to Clifford et al., Noar , Ramstad et al. most patients were satisfied with their appearance after completion of treatment[14,15,16]. Marcusson et al. reported that only 50% of the patients were satisfied with their treatment. Our study revealed that of the eight dimensions studied five of them (physical functioning, role limitations due to physical health, general health, vitality and role limitations due to emotional health had a score of 4 or better, denoting very good quality of life. One score (social functioning) had a score of 3.93 denoting good quality of life. The least two scores were for mental health and bodily pain which scored 3.56 and 3.45 respectively. The overall inference from the scores could mean that though the respondents did not like the way they felt about their problems, they however tried to adjust themselves into society.

Patients with bilateral cleft lip scored a statistically better score in three dimensions: Physical function (+0.5%), Vitalily (+0.9%) and Role Emotional (+2%) as compared to those with unilateral cleft lip defects. The common perception that the bilateral defect being a more disfiguring defect would impede the quality of life is disproved by our study. We feel that this finding should be investigated further to attempt to clear the perception.

To maximize the chances of a positive outcome of care cleft affected individuals who are concerned about their appearance or who experience psychological problems need to be identified by the cleft teams. Intervention by counseling or social interaction skills training should be offered so that the patients' self esteem and social self confidence can be increased. Results of Quality of life studies can be used to improve quality of treatment and also to counsel patients and parents on what to expect from the treatment. Our surgical team has changed the counseling protocols to improve communication with patients and/or their parents and set realistic goals for their treatment. A study comparing the changed strategy to the present is ongoing to assess whether quality of life has improved with improved communication to the patient in the present situation.

## CONCLUSION

This study shows that the presence of a cleft palate is an important factor in the quality of life of a patient with a cleft defect as there is a statistically significant decrease in certain aspects of quality of life of such patients. Patients with bilateral clefts have a better quality of life than patients with unilateral clefts. Females cleft patients have a marginally better quality of life than male patients

Knowledge of potential impacts related to the type of cleft and the gender of the patient will help health care professionals to identify children and families at risk and may help to offer specific support and treatment strategies.

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# CHAPTER 6

# Choice of Incision for Primary Repair of Unilateral Complete Cleft Lip: A Comparative Study of Outcomes in 796 Patients

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ABSTRACT

Background: No one technique of cleft lip repair consistently produces ideal aesthetic and functional results. This study was carried out in a developing, high-volume center. It compares outcomes attained using two different designs of skin incision used for primary closure of unilateral complete cleft lip and sought to identify the most appropriate technique for clefts of varying morphology.

Methods: Seven hundred ninety-six patients were entered into the study. In each group of slightly less than 400 patients, either a modified Millard or Pfeifer wavy line incision was used, both in conjunction with functional repair of the underlying tissues as described by Delaire. Soft-tissue measurements of the lip and nose were recorded preoperatively. Analysis was based on postoperative assessment of the white roll, vermilion border, scar, Cupid's bow, lip length, and nostril symmetry and appearance of the alar dome and base.

Results: Comparison of the two cohorts using Pearson chi-square testing for association and linear trend found a Millard incision gave significantly better results for vermilion match, whereas the Pfeifer method led to a better postoperative lip length. Preconceptions that one particular technique was better suited to certain preoperative cleft anatomical forms were not proven statistically.

Conclusions: Certain preoperative anatomical features may lead the surgeon to choose one particular incision pattern in preference to another, but in this study, it was found that one technique was essentially as good as the other. This suggests that the technique for closure of the underlying tissues is probably of more importance.

## INTRODUCTION

Surgeons have repaired the deformity of cleft lip for the past 2000 years, since the first attempt performed during the Chin Dynasty in China.[1] Many techniques have been used since that time, and it is clearly apparent that no agreement exists as to which represents the optimum method.

Historically, incisions have been either straight line or broken line, but more recently, in the twentieth century, flap design developed over two distinct periods. In the first, up to 1949, and including Le Mesurier,[2] lengthening of the lip on the cleft side was achieved with some sacrifice of the ipsilateral Cupid's bow. This maneuver, however, tended to produce an aesthetically unfavorable peaking of the lip. In the second half of the century, several attempts were made to counter this shortcoming. Tennison[3] utilized a triangular flap on the external surface of the lower margin of the lip, while Petit and Psaume[4] used a superiorly based flap. Nevertheless, because of scar contracture, this latter approach also produced unacceptable aesthetic outcomes. A combination of superior and inferior flaps was used by Trauner[5] and Skoog[6] to counter these problems. A further alternative was described by Malek,[7] who used a flap based on a precisely measured equilateral triangle to achieve perfect equality in the length of the lip on both sides of the cleft. No one technique of lip repair consistently produces ideal aesthetic and functional results.

This study was carried out in a developing, high-volume center receiving large numbers of children with clefts that were anecdotally severe in nature. It compared outcomes attained using two different designs of skin incision used in primary closure of unilateral complete cleft lip and sought to identify the most appropriate technique for clefts of varying morphology. It was designed to give an indication of the best techniques as quickly as possible and, as the study was carried out over the relatively short period of 15 months, by the same group of surgeons, using the

same facilities, randomization was not considered necessary. The method adopted, of studying two successive groups of approximately 400 patients each, may not represent the standard in research, but the authors felt it was justified given the above considerations and the moral and ethical concerns of blinded randomization so well articulated by, among others, Berkowitz.[8]

Among European cleft centers, two now well-established incision patterns for primary unilateral cleft lip repair are represented by the techniques of Millard and Pfeifer. These are examples of rotation-advancement and straight line methods, respectively (Figures 1 and 2).

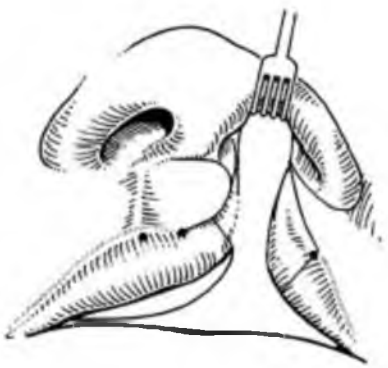

*Figure 1. Marking for the Millard incision*

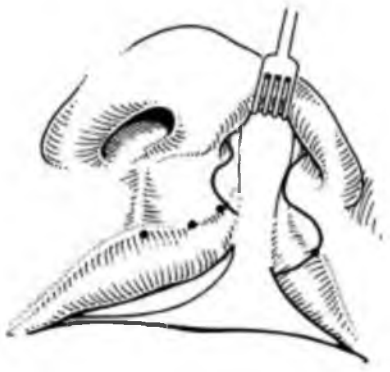

*Figure 2. Marking for the Pfeifer incision*

The Millard repair[1,9] is based on a rotation flap on the noncleft (medial) side coupled with an advancement flap on the cleft (lateral) side. One of its main advantages is that the technique allows adjustment as the operation proceeds, with further rotation and advancement movements tailored to the individual case. It is the more difficult repair of the two, necessitating approximation of a pair of convex curves that ultimately may leave a scar crossing the midline at the base of

the columella. Millard's technique represents a significant advance, elegantly overcoming many of the limitations of previously described methods. In one form or another, it is the most widely practiced method today. The ease with which this technique can be used provides a foundation from which surgeons may develop individual approaches to cheiloplasty as they become more experienced, including Delaire[10], who used a combination of Tennison, Petit and Psaume, Millard, Pfeifer, and, more recently, Mulliken and Martínez Pérez.[11]

Pfeifer designed his incision using the concept of "morphological order".[12] Measurements of non–cleft-side height and length are recorded and translated to the cleft side using a flexible wire, thus determining natural anatomical points. His "straight line" incisions on cleft and noncleft sides are made of equal lengths by incorporating a series of waves leading to a final scar that should follow the lateral line of the philtrum. This incision also frees the excess mucosa located lateral to the columella and medial to the base of the ala. As described below, the two curves are brought together such that the highest and lowest points of one curve are approximated with the corresponding highest and lowest points of the other, thus creating a straight line.

The repair of any cleft lip deformity should of course not just take incision lines into account. Manipulation and repositioning of the mucocutaneous tissues must only be addressed once sound foundations have been laid. A functional anatomical repair of the underlying hard and soft tissues is essential. A primary surgical approach that allows natural facial growth and development, minimizing the need for future secondary procedures, should be every cleft surgeon's goal[13–15].

In the center where this study was conducted, a number of techniques were explored. Initially, the technique of primary cheilorhinoplasty as described by Delaire was used with some success but, with the wide variation in severity of cleft

seen in this region of India, some outcomes were less than satisfactory. In attempts to resolve some of the difficulties encountered by the surgeons, who were at that time relatively inexperienced, frequent variations of technique were made. This study arose out of an awareness that surgery needed to be rationalized and reliable protocols developed if there was to be consistency of outcome in the long term.

## PATIENTS AND METHODS

Seven hundred ninety-six patients who required primary repair of a unilateral cleft lip deformity were enrolled into this study. All patients had a unilateral complete cleft lip defect with or without extension onto the alveolus and palate. Those whose cleft was part of a syndrome were excluded.

In the first cohort of consecutive patients (n=397), a Millard rotation-advancement flap was used. The second group (n=399) underwent a lip repair procedure with a Pfeifer wavy line incision. Irrespective of incision used, all underlying primary surgical repair followed the functional method of Delaire. Patients were grouped by age for preoperative assessment: 12 months or younger, and 12 to 60 months. Four surgeons were involved with individual caseloads of 432, 150, 112, and 102. Each surgeon's caseload was assessed separately by a single surgeon who was not part of the study. Linear measurements were obtained both directly on the patients and using standardized digital photographs (Figs. 3 and 4). Measurements were obtained before surgery and postoperatively at 6 and 12 months and the data recorded on a database.

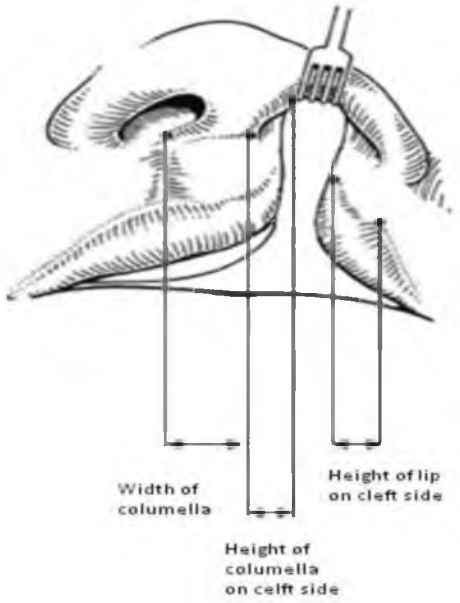


*Figure 3. First set of preoperative measurements*

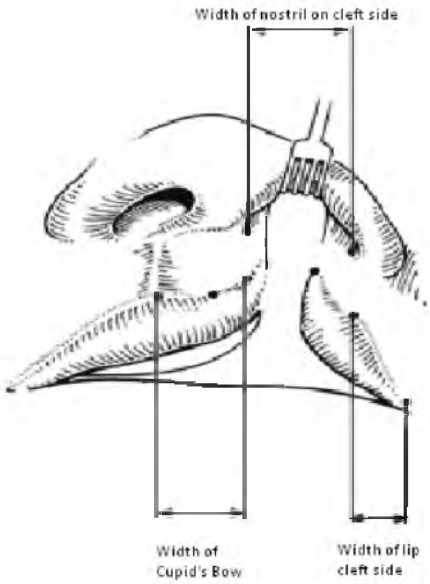


*Figure 4. Second set of preoperative measurements*

The following parameters were assessed: accuracy of white roll and vermilion match, scar appearance, Cupid's bow form, length of lip, nostril symmetry, alar dome form, and alar base position. These eight superficial parameters were chosen because it was felt they represented appropriate, relevant indicators of both aesthetic and functional outcome that could be measured reliably. Each parameter was graded independently as good, average, or poor. Grading criteria are shown in Table 1 and examples of cases are illustrated in Figures 5 through 8.

*Figure 5. Example of repair using a Millard incision. Postoperatively, there is good approximation of the white roll and vermilion, with an average scar. The Cupid's bow form is good, with symmetry of lip lengths on the medial and lateral sides. Nasal dome form is good, but nostril symmetry and alar base both score poorly.*

*Figure 6. Example of repair using a Millard incision. Here, the white roll match and vermilion approximation are average. The scar is also graded as average. There is distortion of the Cupid's bow of more than 2 mm, which grades it as poor. The alar bases are symmetrical but the nasal dome is depressed on the cleft side, with a disparity of nostril height, leading to poor grading in the last two parameters.*

*Figure 7. Example of repair using a Pfeifer incision with good results. White roll and vermilion match are good, but the scar shows some hypertrophy. Cupid's bow form and lip length are both average. The nostrils are asymmetric and are graded as poor because of the height disparity. The form of the alardome is good but there is a discrepancy of the alar bases of over 1mm, leading to a grade of poor.*

*Figure 8. Example of repair using a Pfeifer incision with suboptimal results. All eight postoperative parameters are graded as poor here.*

The postoperative outcomes using the Millard and Pfeifer techniques were compared with regard to each of the eight parameters using the chi-square test for association and the chi-square test for linear trend. To assess whether the relative effectiveness of the two procedures depended on the preoperative cleft form, multinomial logistic regression was used. Medians for Cupid's bow and columella width, columella height, vertical height of lip, lip width, and nostril width on the cleft side were calculated, and for each characteristic, individuals in the sample were divided according to whether or not they fell above the median. This process

was performed separately for children younger than 1 year and those aged 1 to 5 years. Using the eight three-category outcome measures as dependent variables, the relative effectiveness of the two procedures was tested using the interaction effect between procedure and preoperative cleft form. Thus, 48 such analyses were conducted (eight outcomes × six preoperative cleft forms). All analyses were conducted using SPSS for Windows Version 12 (SPSS, Inc., Chicago, Ill.) using a 5 percent significance level.

| | Good | Average | Poor |
|---|---|---|---|
| White roll match | Perfect | Disparity of <1 mm | Disparity of >1 mm |
| Vermilion match | Perfect | Disparity of brown and pink mucosa <1 mm | Disparity of brown and pink mucosa >1 mm |
| Scar appearance | No hypertrophy | Hypertrophy with no disturbance of Cupid's bow or columella | No hypertrophy with disturbance of Cupid's bow or columella |
| Cupid's bow form | Perfect | Distortion on cleft side <2 mm | Distortion on cleft side >2 mm |
| Lip length | Equal length on cleft and noncleft sides | Shortening on cleft side >5 mm and <10 mm | Shortening on cleft side >10 mm |
| Nostril symmetry | Equal in height and width to normal side | >1 mm or <2 mm in either height or width to normal side | >2 mm in either height or width to normal side |
| Alar dome | Equal curvature to the normal side | | Any depression compared with the normal side |
| Alar base | At the same level of the normal side | Difference of <1 mm compared to the normal side | Difference of >1 mm compared with the normal side |

*Table 1: Grading Criteria*

RESULTS

A summary of the results of all cases are shown in Table 2. This allows direct comparison of the Millard and Pfeifer cohorts for each postoperative parameter grading.

| | Good | | Average | | Poor | | | |
|---|---|---|---|---|---|---|---|---|
| | Millard (%) | Pfeifer (%) | Millard (%) | Pfeifer (%) | Millard (%) | Pfeifer (%) | Pearson Chi-Square | Linear by Linear Association |
| White roll match | 232 (58) | 244 (62) | 143 (36) | 124 (31) | 24 (6) | 28 (7) | 0.451 | 0.531 |
| Vermilion match | 231 (58) | 223 (56) | 147 (37) | 128 (32) | 20 (50) | 46 (12) | 0.004 | 0.048 |
| Scar appearance | 242 (61) | 237 (59) | 119 (30) | 115 (29) | 36 (9) | 46 (12) | 0.594 | 0.464 |
| Cupid's bow form | 211 (53) | 225 (57) | 162 (41) | 152 (38) | 24 (60) | 21 (5) | 0.654 | 0.379 |
| Lip length | 211 (53) | 245 (62) | 144 (36) | 132 (33) | 43 (11) | 20 (5) | 0.003 | 0.001 |
| Nostril symmetry | 129 (32) | 108 (27) | 215 (54) | 231 (58) | 54 (14) | 58 (15) | 0.314 | 0.198 |
| Alar dome | 274 (69) | 266 (67) | — | — | 124 (31) | 131 (33) | 0.525 | 0.526 |
| Alar base | 251 (63) | 247 (62) | 134 (34) | 134 (34) | 12 (3) | 17 (4) | 0.723 | 0.518 |

*Table 2: Summary of Results*

In performing chi-square tests for each parameter, it is shown that there are significant differences between the two techniques when assessing vermilion border approximation and lip length. A Millard design flap produced a better approximation of the vermilion ($p$ = 0.004), whereas cases that were operated on

with a Pfeifer incision resulted in a better length of lip ($p$ = 0.003). There were no significant differences in outcome between the two techniques when assessing white roll match, scar appearance or form of Cupid's bow, nostril symmetry, alar dome, and alar base.

Median preoperative characteristics are listed in Table 3. Of the 48 interaction effects tested, only one was statistically significant ($p$ = 0.02), and there is a high risk that this may be attributable to the large number of significance tests conducted. In this analysis, scar appearance appeared to be worse when vertical height of the lip was above the median than if it was below the median for the Pfeifer procedure but not the Millard procedure.

| | <1 Year (mm) | 1–5 Years (mm) |
|---|---|---|
| Width of Cupid's bow | 7 | 8 |
| Width of the lip on the cleft side | 35 | 38 |
| Nostril width on the cleft side | 15.5 | 17 |
| Columella height on cleft side | 2 | 3 |
| Columella width | 4 | 5 |
| Vertical height of lip on cleft side | 8 | 10 |

*Table 3: Median Preoperative Measurements for Age Ranges*

## DISCUSSION

An important cause of the deformities in cleft lip–cleft palate patients is displacement and underdevelopment of the divided parts. Whether the global deformity is attributable to true hypoplasia, diminished function and associated underdevelopment, or a combination of both, the principal surgical goal is the same: to establish good function through careful muscle reconstruction, which in turn will permit optimum subsequent growth and development of the facial skeleton and promote good aesthetic outcomes.

Deformities of cleft lip–cleft palate are, therefore, best managed by adopting a method of primary surgery that not only recognizes the inherent problems but prevents them from occurring. Veau introduced the concept of embryologic surgery. The surgeon must have a full understanding of all the anatomical elements involved in the cleft deformity, should seek to improve surgical methods where failure seems to be apparent, and must make every attempt to restore to normality all the tissues involved in the cleft and in particular the underlying musculature, rather than just confining activity to the overlying skin. Nevertheless, design of the skin incision is an important consideration in the attainment of good outcomes.[16]

It is important to include some discussion regarding limitations in our work. By operating on the two different cohorts successively (i.e., all the Millard incisions first, followed by the Pfeifer incisions), the learning curve for each method was improved with time but, bearing in mind that the overall period of this study was 15 months, this curve was rapid. Outcomes for the individual surgeons, not reported here, confirm this to be the case. Although an ideal study would of course be randomized and blinded, the speed with which this high-volume study was conducted and the constancy of the team and its facilities lend credence to the outcomes. Cleft anatomy is unique in each case when considering the ratio of cleft space to volume of adjacent tissue available for closure. Different outcomes in terms of scarring, aesthetics, growth, and development may therefore be quite independent of the surgeon's skill level or the technique. In addition, it would have been impossible to blind the surgeon assessing results, as each technique has an instantly recognizable scar. Also, as mentioned earlier, the moral and ethical issues surrounding the standard of care in research are difficult to justify in cleft surgery.[8]

This article forms part of a study aiming to identify the optimal incision design used in primary cleft lip repair, in a developing, very-high-volume cleft center. It was stimulated by an awareness of certain difficulties in achieving the optimal outcome

using the Delaire cheilorhinoplasty, such as occasional shortening of lip height. The Euro-cleft survey[16] showed a wide diversity in models of care, national policies, and clinical practices in Europe. Of the 201 centers that registered with the network, the survey showed 194 different protocols being followed for only unilateral clefts. Although there is no indication in the literature that all or none of these protocols produces satisfactory outcomes, the results of the six-center Eurocleft study[17] suggest that constancy of protocol in a multidisciplinary setting leads to the best outcomes.

The two techniques considered here each have their own advantages and shortcomings but individually cannot necessarily be expected to produce the best results in all patients. There were three statistically significant outcomes in this study. First, when assessing postoperative results for vermilion match, the Millard technique produced a better outcome ($p = 0.004$). In this respect, it is rather more flexible than a straight line design and the operator is able to position the rotation flap on the noncleft side where it is judged likely to produce the best outcome. Second, lip length was significantly better with the Pfeifer incision ($p = 0.003$). By its nature, the more waves incorporated in the incision, the greater the height of the lip. A prominent wave placed just above the mucocutaneous junction will tend to exaggerate this factor.

As the study developed, it was the belief of the four surgeons that each technique lent itself to certain preoperative morphologic characteristics of cleft anatomy. The Millard flap was considered to produce better results where, preoperatively, the width of lip and nostril on the cleft side fell in the upper ranges of measurements (i.e., a wide lip) and the Cupid's bow was prominent. Where this was the case, it was deemed that there would be a natural reduction in rotational requirement of the flap on the medial side resulting in less distortion and a Cupid's bow with better

form. The Pfeifer incision pattern seemed to be more appropriate when the vertical dimensions of lip and columella were above the mean.

However, these suppositions were not supported by robust statistical analysis. With respect to the median preoperative characteristics as shown in Table 3, of the 48 interaction effects tested, only one was statistically significant ($p$ = 0.02), and there is a high risk that this may have been attributable to the large number of significance tests conducted. In this analysis, scar appearance appeared to be worse when vertical height of the lip was above the median than if it was below the median for the Pfeifer procedure but not the Millard procedure. In other words, use of the Pfeifer incision certainly maintained lip length better than the Millard procedure as shown above, but where the initial length of the lip was above the median, the scar created is inevitably going to be longer and thus more noticeable.

The fact that otherwise the results were so similar lends credence to the importance of the method used to restore the underlying structural discontinuity, in this case, the method described by Delaire. Delaire himself incorporated methods used by Millard and Pfeifer in developing his now widely practiced technique.[18–20] The authors feel that a sound underlying functional repair of muscle, cartilage, periosteum, and bone is the most important factor in cleft lip repair rather than one particular mucocutaneous flap design.

This study reviews early outcomes of particular techniques used in high volume, a volume not previously reported. Longer term outcomes would ideally be reported, but given the logistic and economic difficulties faced by many of the patients, this may not prove possible. However, in view of the findings of this study, modifications of technique will be made and reported in the future.

## CONCLUSIONS

We feel that this large series lends support to the belief that no single technique of cleft lip repair is a panacea for all cases. Individual clefts need to be managed with a philosophy incorporating ideas from several methods that can be adapted in a flexible manner by the surgeon to fit a particular need.

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# CHAPTER 7

# Afroze Incision for Functional Cheiloseptoplasty

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ABSTRACT

Repair of unilateral cleft lip is a fascinating and challenging procedure. Although a great number of operations have been described for the unilateral cleft lip repair, none fulfill all the plastic surgical criteria, and in most cases, cleft lip repairs require secondary operations in an attempt to achieve described goals of primary cheiloplasty. The Afroze incision is a combination 2 incisions, that is, the Millard incision on the noncleft side and Pfeiffer incision on the cleft side. The flap design is the Millard flap on the noncleft side rotated downward, and the peak of the distal curve of the Pfeiffer flap is positioned in the triangular defect formed by the movement of the Millard flap. The proximal curve lengthens downward to receive the Millard's "C" flap. The advantage of this technique is that there is no tension on the postoperative scar because the incision is essentially horizontal in nature, and the contracture of the scar occurs horizontally rather than vertically. Primary septal repositioning is performed, which provides stability and exact positioning of the previously lifted alar crus of the cleft side and nasal tip, and the nose can grow in a balanced way with equal muscular force being exerted on both sides. This incision can be used in all types of complete unilateral cleft lip regardless of the width of the cleft, shortening the cleft lip segment.

INTRODUCTION

Repair of unilateral cleft lip is a fascinating and challenging procedure. The aims of a unilateral cleft lip repair are to achieve a lip length on the cleft side matching that on the normal side, an inconspicuous residual scar that does not cross anatomic boundaries, an adequate Cupid's bow width, an absence of notching of the vermilion border (whistle tip deformity), and an absence of peaking of the vermilion at the Cupid's bow on the cleft side. Although a great number of operations have been described for the unilateral cleft lip repair, none fulfill all the above criteria, and in most cases, cleft lip repairs require secondary operations in an attempt to achieve this described goal[1] .

The Millard repair is based on a rotation flap on the noncleft (medial) side coupled with an advancement flap on the cleft (lateral) side. One of its main advantages is that the technique allows adjustment as the operation proceeds, with further rotation and advancement movements tailored to the individual case. It requires the approximation of a pair of convex curves that ultimately may leave a scar crossing the midline at the base of the columella. The Pfeiffer incision is designed using the concept of "morphologic order." Measurements of noncleft side height and length are recorded and translated to the cleft side using a flexible wire, thus determining natural anatomic points. The 2 curves are brought together such that the highest and lowest points of 1 curve are approximated with the corresponding highest and lowest points of the other, thus creating a straight line[2].

On comparison of the 2 techniques, each has its own advantages and shortcomings. The Millard flap produced better results when considering vermilion approximation. In this respect, it is rather more flexible than a straight line design, and the operator is able to position the rotation flap on the noncleft side where it

is judged likely to produce the best outcome. This technique also has an improved outcome where preoperatively the lip is wider on the noncleft side. This would lead to a reduction in rotational requirement of the flap on the medial side, resulting in less distortion and a Cupid's bow with better form. Repairs using flaps according to Pfeiffer's design resulted in a better length of lip postoperatively. By its nature, the more waves incorporated in the incision, the greater the height of the lip. A prominent wave placed just above the mucocutaneous junction will tend to exaggerate this factor[2].

Afroze incision is a combination of 2 incisions, Millard incision on the noncleft side and Pfeiffer incision on the cleft side. The flap design is such that Millard flap on the noncleft side is rotated downward, and the peak of the distal curve of the Pfeiffer flap is positioned in the triangular defect formed by the movement of the Millard flap. The proximal curve lengthens downward to receive the Millard's "C" flap. The advantage of this technique is that there is no tension on the postoperative scar because the incision is essentially horizontal in nature and the contracture of the scar occurs horizontally rather than vertically. There is also no pressure on the Cupid's bow for the same reason.

INCISION MARKING

On the noncleft side, the Cupid's bow is marked by 3 points. Point 1 is the highest point on the contralateral white roll; point 2 is the deepest point on the white roll. Point 3 is marked on the white roll at a distance that is 2 mm more than the distance between points 1 and 2.

On the cleft side, point 4 is marked at a point where the white roll begins to fade (Figs. 1-3).

The Millard incision on the noncleft side is extended from point 3 along the junction of skin and vermillion mucosa and further up along the junction of the skin

and nasal mucosa and then turned down lateral to the base of columella to finish in front of the columella. The variation of the Millard incision here is that it does not cut across the base of the columella. The incision can be extended further during surgery using a back-cut if more rotation is required.

On the cleft side, the Pfeiffer incision is started from point 4 on the white roll. The incision starts from this point to go laterally and then curve back to the junction of the skin and vermillion mucosa. From here, it continues along the junction of the skin and nasal mucosa to then turn upward perpendicularly along the junction of the hair-bearing and non-hair-bearing nasal mucosa, stopping at a distance that is approximately one third of the distance on the inner part of the ala (Figs. 1-3).

On both sides, the incision is extended anteriorly onto the vermillion at right angles to the incision and continued medially to meet the first part of the incision over the cleft alveolus. On the cleft side, an incision is also made from the distal wave, down on the lateral part of mucosa along the cleft alveolus. Both the above lateral incisions expose the cleft alveolus and piriform area. The mucosa covering the area medial to the 2 incisions (sterile zone) is removed. After the muscle dissection is done, the alveolar flaps are detached from the cleft margins subperiosteally. On the cleft side, minimal dissection is done to expose the orbicularis oris muscle. However, extensive dissection is done to expose the malposed nasal part of the nasalis muscle. This muscle lies beneath the distal “V” flap of the Pfeiffer wave and can easily be exposed in this technique (Fig. 4).

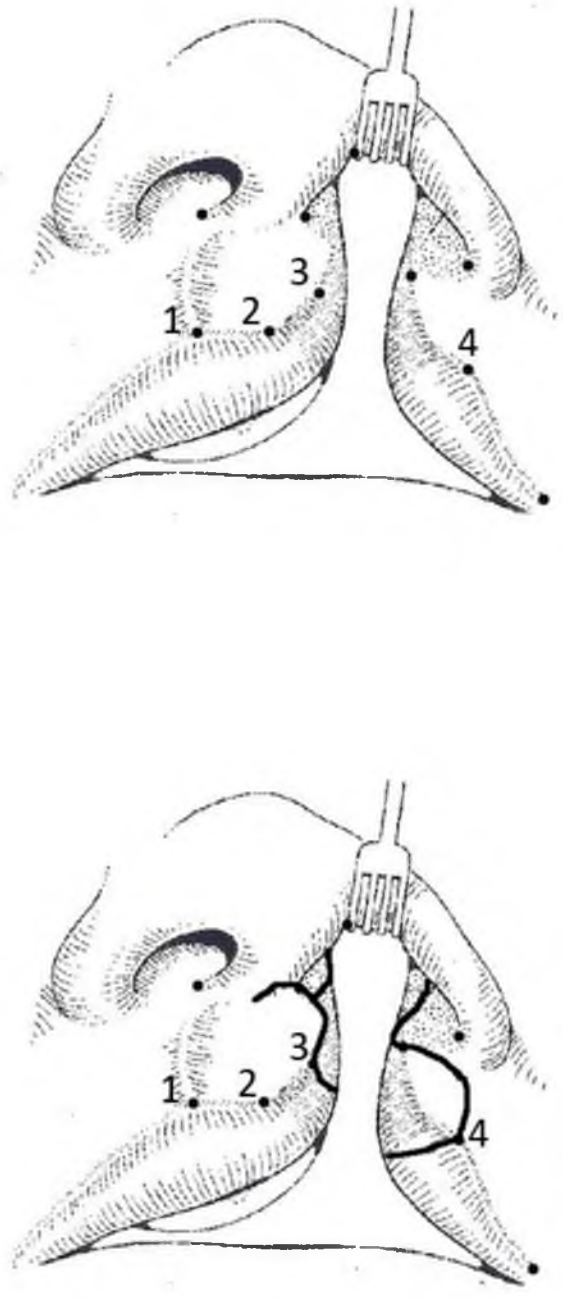


*Figure 1. Afroze incision marking.*

*Figure 2. Clinical photograph of Afroze incision marking on the non-cleft side.*

*Figure 3. Clinical photograph of Afroze inicision marking the cleft side.*

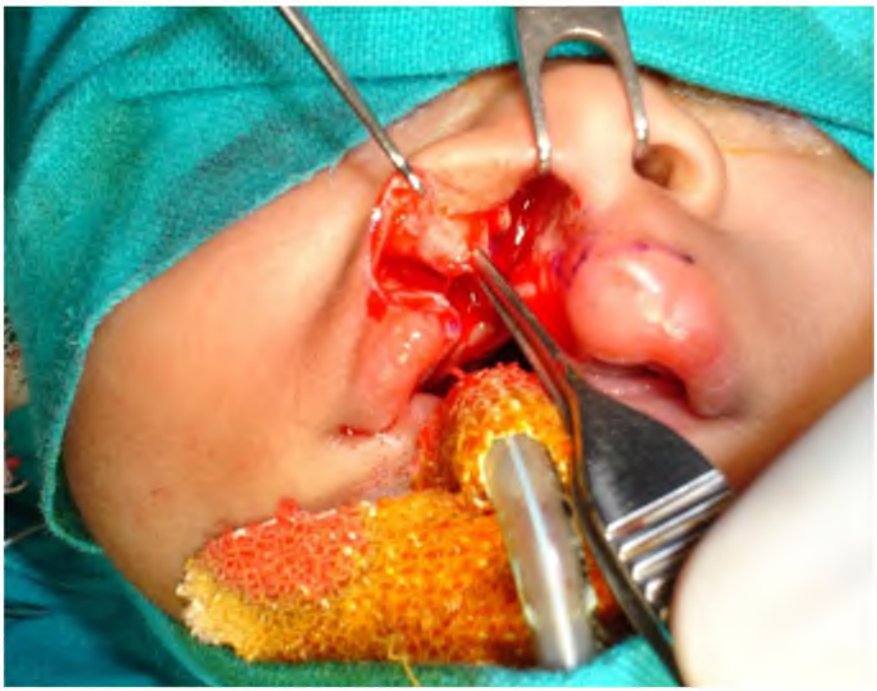

*Figure 4. Nasalis muscle dissection on the cleft side.*

SEPTUM IS THE KEY

Not touching the cleft lip nose in primary cleft lip repair was dogmatic in the past, although it meant severe functional, aesthetic, and psychologic problems for the child. This attitude was defended vehemently, even fanatically, by many surgeons who were afraid that growth impairment might occur[3]. Theoretical basis of septal repositioning during primary cheiloplasty is that most nasal and deep bundles of orbicularis muscle in unilateral cleft lip patients insert to the mucoperichondrium and anterior nasal septum. Correction of the deviated septum is important because it provides stability and exact positioning of the previously lifted alar crus of the cleft side and nasal tip, and the nose can grow in a balanced way with equal muscular force being exerted on both sides. Studies have demonstrated that no negative sequel can be observed after manipulation of the septum in children[4]. If no primary correction is performed, breathing problems through the nose persist until late corrections are made. The correct placement of the septum can be

achieved only through very tightly adherent perichondrium. Perichondrium is completely freed from the cartilage on both sides. Otherwise, the septum will always swing back into its original position. The anterior nasal spine is located by subperiosteal dissection, and all attachments to it are separated. The septum is then carefully isolated through the same incision by splitting and raising the perichondrium on both sides (Fig. 5). The septum is detached from its attachment to the nasal spine and maxillary crest and straightened. The perichondrium around the detached septum is sutured together with mucopericondrium and a passive non resorbable suture from the ala nasalis.M from cleft side to non cleft side in such a way that the septum is now in its central position though not resting on the anterior part of the maxilla (Fig. 6). The nasal sill is sutured next by joining the hair-bearing nasal mucosa on both sides. The 2 lateral flaps in the alveolus aresutured to complete the perioplasty.

The nasalis muscle is then positioned below the nasal sill and attached to the contralateral nasalis muscle to form a sling to support the nasal sill on the cleft side, septum, and ala. After nasalis repositioning is completed, the orbicularis oris muscle is sutured to its counterpart. The skin suturing is done by first securing the white roll with a suture above and below it. This is done by joining point 3 on the Cupid's bow to point 4 on the cleft-side white roll. The C flap is then usually already sufficiently rotated downward to fill the proximal Pfeiffer wave. This flap is essentially horizontally positioned, resulting in a horizontal scar. The rotation downward of the C flap causes a V-shaped defect in front of the columella, which is filled with the distal V flap of the Pfeiffer wave. Nasal pack and pressure dressing are applied (Fig. 7).

*Figure 5. Dissection of deviated nasal septum.*

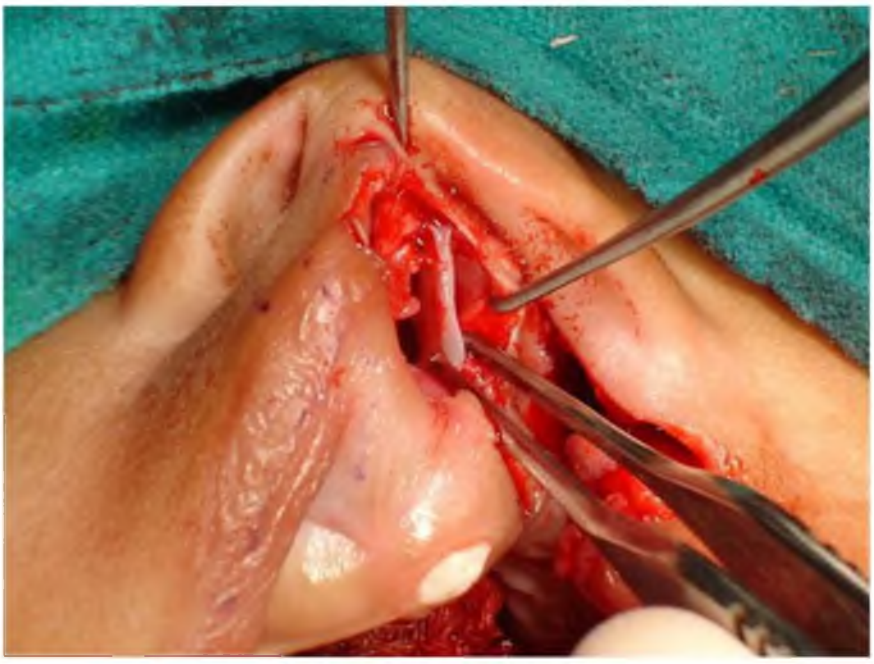

*Figure 6. Repositioned nasal septum.*

*Figure 7. Approximation of the "C" flap.*

Figure 8 shows the long-term outcome of a unilateral complete cleft lip operated using the functional cheiloplasty using Afroze incision. The advantages of this method are septal repositioning, horizontal scar, and good nasal symmetry.

*Figure 8. Long-term follow-up of primary cheiloseptoplasty done using Afroze incision.*

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# CHAPTER 8

# Comparison of Three Incisions to Repair Complete Unilateral Cleft Lip

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ABSTRACT

Background: The incision design for correcting a unilateral cleft lip is important because all subsequent stages of surgery depend on the access and maneuverability of the incision. This prospective cohort study compares the aesthetic and functional outcomes of three different skin incisions for primary unilateral cleft lip repair.

Methods: Patients with complete unilateral cleft lips (n = 1200) were enrolled and divided into three groups of 400 patients. Each group of patients was operated on with the Millard incision, Pfeifer wave line incision, or Afroze incision. Outcome assessments were performed 2 years postoperatively and consisted of assessment of the white roll, vermilion border, scar, Cupid's bow, lip length, nostril symmetry, and appearance of alar dome and base.

Results: With regard to white roll, vermilion border, scar, Cupid's bow, and lip length, the Afroze incision always gave superior results compared with the Millard or Pfeifer incision. Depending on the cut-off for treatment success, the Afroze incision also showed better results regarding nostril symmetry. With respect to the alar base and alar dome, all three incisions showed comparable outcomes.

Conclusion: The Afroze incision is superior regarding a broad spectrum of outcomes in a heterogeneous population of patients with unilateral cleft lip.

INTRODUCTION

The anatomical basis for a cleft lip defect is far removed from the normal orientation. Compared with the noncleft patient, the three groups of superficial facial muscles (i.e., the nasolabial, bilabial and labiomental) are all displaced inferiorly.[1] The orbicularis oris muscle finds a new and abnormal insertion on the cleft side and a partially distorted insertion on the noncleft side[2]. The Cupid's bow on the cleft side and the white skin roll on both sides are also distorted.[3] The treatment goals for cleft lip defects are early correction of the cleft, with primary correction to a tension-free, mobile and balanced lip[4].

The repair of any cleft lip deformity should take not just incision lines into account. A functional anatomical repair of the underlying hard and soft tissues is essential. Manipulation and repositioning of the mucocutaneous tissues must be addressed only once sound foundations have been laid. A primary surgical approach that allows natural facial growth and development, minimizing the need for future secondary procedures, should be every cleft surgeon's goal[5].

Many surgical techniques and flap designs have been documented to repair unilateral cleft lips[6-10]. Probably the most commonly used is the rotation-advancement technique described by Millard[11,12]. The Millard incision is based on a rotation flap on the noncleft side coupled with an advancement flap on the cleft side[11,12] . In one form or another, it is the most widely practiced method today[5].
The Pfeifer incision is designed using the concept of "morphological order". Measurements of the noncleft side height and length are recorded and translated to the cleft side using a flexible wire, thus determining natural anatomical points. The "straight line" incisions on cleft and noncleft sides are made of equal lengths by incorporating a series of waves leading to a final scar that should follow the lateral line of the philtrum[13].

In an earlier study conducted at the same institute, the esthetic and anatomical differences between the two incisions were compared and some significant differences in assessing post operative results were found. First, for vermilion match, the Millard technique produced a better outcome. Second, lip length was significantly better with the Pfeifer incision[5]. The study also concluded that neither incision was predominantly better than the other[5].

A new design variant incision was developed, combining the Millard incision on the noncleft side (medial side) and the Pfeifer incision on the cleft side (lateral side). This was performed to use the advantages of the Millard incision on the noncleft side which needs rotation and the Pfeifer incision on the cleft side, which needs lengthening. This incision was called the Afroze incision and has been used in this center since 2002[14]. In this incision design, the Millard flap on the noncleft side is rotated downwards and the peak of the distal curve of the Pfeiffer flap is positioned in the triangular defect formed by the movement of the Millard flap. The proximal curve lengthens downwards to receive the Millard C flap[14].

The purpose of the present study was to compare the aesthetic and functional outcomes of the three different skin incisions and flap designs for primary unilateral cleft lip repair.

## PATIENTS AND METHODS

### *Patients*

In this prospective cohort study, 1200 patients were included over a period of 4 years. The first cohort of patients was treated using the Millard incision between September of 2001 and October of 2002; the second cohort of patients was treated using the Pfeifer incision between November of 2002 and January of 2004; and the last cohort of patients was treated using Afroze incision between February of 2004 and March of 2005. All patients had a complete unilateral cleft lip with or without cleft palate. Only non-syndromic patients, who were operated on before age 5

years, were considered. The patients were divided into three cohorts of 400 patients each.

*Surgical procedures*

The first cohort was treated using the Millard incision, the second cohort was treated using the Pfeifer incision and the last cohort was treated using the Afroze incision. Irrespective of incision used, all underlying primary surgical repair followed the functional method of muscle repair as detailed by Delaire[15]. Four surgeons were involved and their individual case loads were 536, 322, 176, and 166, respectively. All 4 surgeons involved had a balanced caseload with regard to the three techniques.

*Data Collection*

Data collection was performed at 6 months and 2 years postoperatively. Only the 2 year postoperative data was considered.

All patients who were enrolled in the study were recalled at 2 years postoperatively on the first three Saturdays of each month. Thirty patients were seen at each sitting by all four operating surgeons as a group. The four surgeons were also the observers. The surgeons were blinded to the patient's name and to the name of the surgeon who performed the surgery. Physical measurements were performed on the patients and recorded. Any disagreement between the surgeons was resolved through consensus. The measurements were obtained with the help of calipers that could measure in units of 1 mm. The data was entered into a grading list for eight outcome parameters (Table 1): (1) white roll match, (2) vermilion match, (3) scar appearance, (4) Cupid's bow form, (5) length of lip, (6) nostril symmetry, (7) alar dome form, and (8) alar base position. Each parameter was graded independently as good, average or poor. Standardized 1:1 photographs of

the patients were taken preoperatively and postoperatively for record keeping. (Figs. 1 through 6).

| | Good | Average | Poor |
|---|---|---|---|
| **White roll match** | Perfect | Disparity of ≤1mm | Disparity of >1mm |
| **Vermilion atch** | Perfect | Disparity of brown and pink mucosa ≤1mm | Disparity of brown and pink mucosa >1mm |
| **Scar appearance** | No hypertrophy | Hypertrophy with no disturbance of Cupid's bow or columella | Hypertrophy with disturbance of Cupid's bow or columella |
| **Cupid's bow form** | Perfect | Distortion on cleft side ≤2mm | Distortion on cleft side >2mm |
| **Lip Length** | Difference of ≤5 mm length on cleft and noncleft sides | Shortening on cleft side >5mm and ≤10mm | Shortening on cleft side >10mm |
| **Nostril symmetry** | Difference of ≤1 mm in height and width with noncleft side | > 1mm or ≤ 2 mm in either height or width with the non-cleft side | > 2 mm in either height or width with noncleft side |
| **Alar dome** | Equal curvature to the noncleft side | | Any depression compared with the noncleft side |
| **Alar base** | At the same level of the noncleft side | Difference of ≤1 mm compared with the noncleft side | Difference of >1 mm compared with the noncleft side |

*Table 1: Grading Criteria for Quality of the Lip Repair*

*Figure 1.Preoperative and postoperative frontal views of repair performed with the Millard incision, with a good score on all parameters*[1].

*Figure 2.Preoperative and postoperative Worm's-eye views of repair performed with the Millard incision, with a good score on all parameters*[1].

[1] From Reddy GS, Webb RM, Reddy RR, Reddy LV, Thomas P, Markus AF. Choice of incision for primary repair of unilateral complete cleft lip: A comparative study of outcomes in 796 patients. Plast Reconstr Surg. 2008;121:932-940.

*Figure 3. Preoperative and postoperative frontal views of repair performed with Pfeıfer incision, with a good score on all parameters.*

*Figure 4. Preoperative and postoperative worm's-eye view views of repair performed with the Pfeifer incision with a good score on all parameters.*

*Figure 5. Preoperative and postoperative frontal views of repair performedwith the Afroze incision, with a good score on all parameters.*

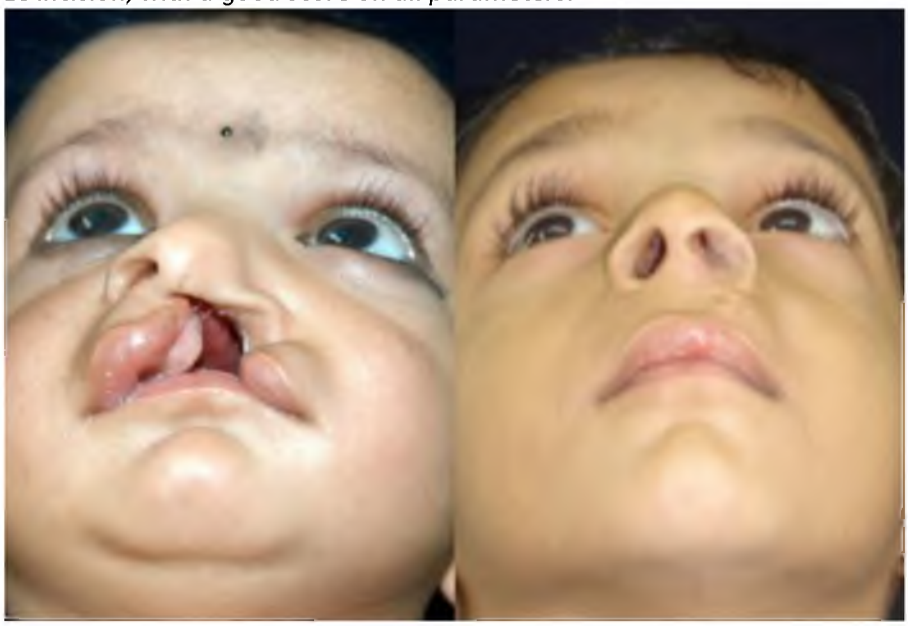

*Figure 6. Preoperative and postoperative worm's-eye views of repair performed with the Afroze incision with a good score on all parameters.*

*Statistical analysis*

The postoperative outcomes using the Millard, Pfeifer, and Afroze incisions were compared with regard to each of the eight parameters separately. This was performed using logistic regression. Logistic regression is a technique that serves to analyze multiple independent variables simultaneously. The analysis evaluates what effect the intervention has on the chance of achieving "success" with a dichotomous dependent variable (i.e. a variable indicating either "success" or "failure"). The effects of the independent variables are expressed as odds ratios. The odds ratio can be interpreted as the ratio of the chance of achieving success in the alternative group and the chance of success in the reference group. In the analyses in this article, Millard is the reference group. To make this technique applicable, the outcome criteria need to be of the type success or failure. Therefore, the scale consisting of good, average or poor needs to be modified. This was performed twice, first by combining average and poor criteria and second by combining average and good criteria. To correct for potential confounding, gender and presence of a palatal cleft were added as controlling variables to the logistic model. The Millard incision was used as the reference category. SPSS version 16.0 (SPSS, Inc., Chicago, III.) was used for statistical analysis.

To assess observer performance, photographs taken at the time of the original scoring of the patients were scored 2 to 4 years afterwards. This was performed for a random sample of 30 patients per technique, and was performed by three of the original four observers. If disagreement arose, the majority score was used. This majority score was compared with the original scores. Agreement was analyzed using the kappa statistic[16].

RESULTS

As gender and presence of a palatal cleft were part of the logistic regression as controlling variables for potential confounding, only the results found for the variables in the incisions involved were reported.

Table 2 shows the sample distribution details according to gender and the presence or absence of a palatal cleft, and the surgical technique.

| | | Millard | Pfeifer | Afroze |
|---|---|---|---|---|
| **Sex** | Female | 200 | 148 | 185 |
| | Male | 200 | 252 | 215 |
| **Age, years** | Mean | 2.21 | 1.93 | 1.66 |
| | SD | 1.70 | 1.65 | 1.42 |
| | Minimum | 0.25 | 0.25 | 0.33 |
| | Maximum | 5.00 | 5.00 | 5.00 |
| **Presence of a palatal cleft** | No | 50 | 98 | 99 |
| | Yes | 350 | 302 | 301 |
| **Total** | | 400 | 400 | 400 |

*Table 2: Description of the Experimental Groups*

Table 3 shows the kappa statistics of late intraobserver performance, which was performed 2 to 4 years later on photographs for the eight grading criteria. The values for kappa ranged between 0.776 (scar appearance) and 0.900 (alar dome). This indicates good to very good, intraobserver agreement.

| Criteria | *Kappa* |
|---|---|
| **White roll match** | 0.829 |
| **Vermillion match** | 0.856 |
| **Scar appearance** | 0.776 |
| **Cupid's bow** | 0.845 |
| **Lip length** | 0.824 |
| **Nostril symmetry** | 0.852 |
| **Alar dome** | 0.824 |
| **Alar base** | 0.900 |

*Table 3. Results of Intraobserver Analyses*

Table 4 shows the frequency for good, average, and poor grading for the postoperative outcomes for the three incisions.

Logistic regression models were then used to analyze whether the Afroze and Pfeifer incisions were improvements over the Millard incision. Results of these analyses are listed in Table 5. For example, to judge the Cupid's bow, all cases that are graded good are an indicator for successful treatment. In this case, with regard to the Afroze-Millard comparison, a statistically significant effect was found ($p<0.001$). The value of the odds ratio shows that the chance of achieving success when applying the Afroze instead of the Millard incision is approximately 2.06 times larger. Because this value for the odds ratio is an estimate based on a patient sample, a certain level of uncertainty is present. The magnitude of this can be seen in the 95% confidence limits for the estimated odds ratio, which shows the values between which the odds ratio can be found with 95 percent certainty. In this case, the 95 percent confidence interval is 1.55 to 2.78. With regard to the Pfeifer-

Millard comparison, the estimated effect of achieving success when applying the Pfeifer incision instead of the Millard incision is an increased chance of success by a factor 1.17 (95 percent confidence interval, 0.88 to 1.56). This effect is not statistically significant (p = 0.268).

| | Technique | Good | | Average | | Poor | |
|---|---|---|---|---|---|---|---|
| **White roll match** | Millard | 232 | 58% | 143 | 36% | 25 | 6% |
| | Pfeifer | 246 | 62% | 126 | 32% | 28 | 7% |
| | Afroze | 291 | 73% | 106 | 27% | 3 | 1% |
| **Vermillion match** | Millard | 233 | 58% | 147 | 37% | 20 | 5% |
| | Pfeifer | 224 | 56% | 130 | 33% | 46 | 12% |
| | Afroze | 273 | 68% | 122 | 31% | 5 | 1% |
| **Scar appearance** | Millard | 243 | 61% | 120 | 30% | 37 | 9% |
| | Pfeifer | 238 | 60% | 116 | 29% | 46 | 12% |
| | Afroze | 268 | 67% | 121 | 30% | 11 | 3% |
| **Cupid's bow** | Millard | 213 | 53% | 163 | 41% | 24 | 6% |
| | Pfeifer | 226 | 57% | 152 | 38% | 22 | 6% |
| | Afroze | 279 | 70% | 112 | 28% | 9 | 2% |
| **Lip length** | Millard | 212 | 53% | 145 | 36% | 43 | 11% |
| | Pfeifer | 248 | 62% | 132 | 33% | 20 | 5% |
| | Afroze | 261 | 65% | 126 | 32% | 13 | 3% |
| **Nostril symmetry** | Millard | 129 | 32% | 217 | 54% | 54 | 14% |
| | Pfeifer | 108 | 27% | 234 | 59% | 58 | 15% |
| | Afroze | 186 | 47% | 167 | 42% | 47 | 12% |
| **Alar dome** | Millard | 276 | 69% | 0 | 0% | 124 | 31% |
| | Pfeifer | 268 | 67% | 0 | 0% | 132 | 33% |
| | Afroze | 290 | 73% | 0 | 0% | 110 | 28% |
| **Alar base** | Millard | 254 | 64% | 134 | 34% | 12 | 3% |
| | Pfeifer | 249 | 62% | 135 | 34% | 16 | 4% |
| | Afroze | 275 | 69% | 115 | 29% | 10 | 3% |

*Table 4. Results for all Eight Criteria by Technique*

| | | A[1] | | | | B[2] | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Incision | p | OR | 95% CI of OR | | p | OR | 95% CI of OR | |
| | | | | lower | upper | | | lower | upper |
| **White roll match** | Pfeifer | 0.388 | 1.13 | 0.85 | 1.51 | 0.580 | 0.85 | 0.48 | 1.50 |
| | Afroze | <0.001 | 1.9 | 1.41 | 2.56 | 0.001 | 8.53 | 2.55 | 28.57 |
| **Vermillion match** | Pfeifer | 0.498 | 0.91 | 0.68 | 1.20 | 0.001 | 0.39 | 0.23 | 0.68 |
| | Afroze | 0.004 | 1.54 | 1.15 | 2.06 | 0.006 | 4.04 | 1.50 | 10.9 |
| **Scar appearance** | Pfeifer | 0.900 | 1.02 | 0.76 | 1.36 | 0.449 | 0.84 | 0.52 | 1.33 |
| | Afroze | 0.022 | 1.41 | 1.05 | 1.89 | <0.001 | 3.84 | 1.91 | 7.69 |
| **Cupid's bow** | Pfeifer | 0.268 | 1.17 | 0.88 | 1.56 | 0.268 | 1.17 | 0.88 | 1.56 |
| | Afroze | <0.001 | 2.06 | 1.55 | 2.78 | <0.001 | 2.08 | 1.55 | 2.78 |
| **Lip length** | Pfeifer | 0.012 | 1.44 | 1.09 | 1.92 | 0.001 | 2.51 | 1.43 | 4.41 |
| | Afroze | 0.001 | 1.66 | 1.25 | 2.21 | <0.001 | 3.93 | 2.06 | 7.50 |
| **Nostril symmetry** | Pfeifer | 0.129 | 0.79 | 0.58 | 1.07 | 0.833 | 0.96 | 0.64 | 1.44 |
| | Afroze | <0.001 | 1.85 | 1.38 | 2.47 | 0.378 | 1.21 | 0.79 | 1.85 |
| **Alar dome** | Pfeifer | 0.836 | 0.97 | 0.72 | 1.31 | 0.836 | 0.97 | 0.72 | 1.31 |
| | Afroze | 0.158 | 1.25 | 0.92 | 1.70 | 0.158 | 1.25 | 0.92 | 1.70 |
| **Alar base** | Pfeifer | 0.660 | 0.94 | 0.70 | 1.25 | 0.432 | 0.73 | 0.40 | 1.59 |
| | Afroze | 0.142 | 1.25 | 0.93 | 1.68 | 0.680 | 1.12 | 0.51 | 2.83 |

*Table 5. Results of Multivariate Logistic Regression with the Millard incision as the Reference Technique*

[1]**A:** Success is defined as a grading of good, and failure is defined as a grading of average or poor.

[2]**B**: Success is defined as a grading of good or Average, and failure is defined as a grading of poor.

DISCUSSION

This study is an observational study and not a randomized clinical trial, the latter being the study design best suited for comparing effects of different treatments. There are some advantages to prospective randomized clinical trials to resolve some limited clinical problems. However, when this method is used to determine the best surgical procedure, there are strong ethical considerations that cannot be overcome.[17] A major problem is having the surgeon perform surgical procedures that he or she does not believe is the treatment of choice or can be performed as skillfully as others, even after demonstrations.[17] The major drawback of a nonrandomized design, however, is selection bias resulting in experimental groups that are not fully comparable. Therefore, comparison between treatment effects can be confounded by differences between the patient groups. In this study, all eligible patients in each cohort were treated successively and not concurrently. The Afroze incision was developed as a result of the surgeons' experience with the Millard incision and the Pfeifer incision. Therefore, a nonrandomized study was designed, as the Afroze incision was developed after the Millard and Pfeifer incisions. Because each cohort of 400 operations took not more than 15 months to complete, the results were not found to be significantly confounded with regards to the learning curve for each incision.

Patients were evaluated by scoring them on eight parameters, using a three-point scale (poor, average, or good) by four surgeons. In case of disagreement, a consensus decision was made. For assessing observer performance, it would have been ideal to redo the original scoring method. However, this would require a recall of patients, which was not feasible. Therefore, the duplo analysis was based on comparing the original data, gathered with the patient present and the duplo scoring performed later based on patient photographs. Here, there is more chance for observer error; thus the kappa statistics calculated underestimate the true

observer performance. As no standard exists for the evaluating parameters, the extent to which measurement errors were made cannot be ascertained. However, because measurements errors are an extra source of variation, they will lead to less clear-cut results. This study shows strong results, indicating that potential misclassification is not to be considered a serious problem.

It is impossible to blind the observers for the treatment because each observer can identify the incision design by looking at the course of the scar. However, as there was clinical equipoise among the panel of surgeons over whether or not any of the techniques would be more beneficial, the study can be taken for being unbiased in this respect.

A major drawback of clinical studies can be considerable numbers of dropouts. In the present study, we avoided losing patients by scheduling the study during the normal recall appointments of cleft patients. Every patient on our rolls is obligated to come back for a period of 2 years to receive incentives in the form of disability benefits.

In analyzing the differences between the three methods, a choice had to be made on how to define success. This could be achieved by considering only the grading good or good combined with average. In the first case, the Afroze incision has performed statistically significantly better than the Millard incision for sex of the eight parameters (i.e. white roll match, vermillion match, scar appearance, Cupid's bow, lip length and nostril symmetry). By performing the alternative analysis, only the statistically significance for nostril symmetry is lost. For all five occurrences (two plus three) where the difference between the Afroze and the Millard incisions is not statistically significant, the odds ratio is greater than 1, indicating a better performance by the Afroze incision, although not enough to be statistically significant. With regard to alar dome and base, the Afroze incision is not statistically significantly better than the Millard incision. However, for both parameters, the estimated ratio is greater than 1, indicating more success for the Afroze as compared to the Millard incision. The reason for this could be that the

nasal reconstruction of the cleft lip in both the Afroze and Millard incisions is essentially similar, with both techniques using the free tissue lateral to the columella and medial to the ala to form the nasal sill.

When comparing the Afroze incision with the Millard incision, both choices for definition of success give the same overall picture. When comparing the Pfeiffer incision with the Millard incision, some parameters show the Pfeiffer incision to be better, whereas for others the Millard incision shows the best results. However, these differences are generally not statistically significant, with three exceptions. The Pfeiffer incision is better than the Millard incision with regard to lip length for both choices of success. If good or average indicates success, the Millard incision is better than the Pfeiffer incision with regard to vermillion match.

This can be explained by the initial logic of combining the two incisions. In the cleft defect, there are two issues to be taken into account with regard to the skin and mucosa. First, the Cupid's bow on the noncleft (medial side) is rotated upwards so that its direction is perpendicular to the base of the columella instead of being parallel as in normal subjects. The second is the distance between the white roll of the lip and the alar base being less compared to the normal subjects on the cleft side (lateral side). Thus, it can be inferred that the Cupid's bow needs to be rotated downward to restore to its original position during cleft lip repair. The Millard incision is ideally suited to perform this movement. The Pfeifer wave that receives the Millard incision frees up the mucosa on the cleft side thus naturally increasing the height of the lip.

## CONCLUSIONS

The choice of technique for primary surgery for cleft lip should be based on evidence that shows the best functional and aesthetic outcomes. Certain preoperative anatomical features may lead the surgeon to choose one particular incision pattern in preference to another, but in this study it was found that the Afroze incision was suited to all types of cleft lip repairs.

Every cleft lip defect is different in its width and height. The Afroze incision can be used on a variety of cleft defects irrespective of anatomical differences in the width and height of the cleft. This is because the nature of the incisions provides both rotation and elongation of the lip, where it is needed. This incision can therefore be used to treat any variety of cleft.

The alar dome and alar base are two areas where the Afroze incision did not perform better than the Millard of Pfeifer incision. The aim of this group of surgeons is to find ways to improve on the nasal aspect of the cleft lip defect.

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# CHAPTER 9

# Primary Septoplasty in the Repair of Unilateral Complete Cleft Lip and Palate

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ABSTRACT

Background: To assess and compare nasal symmetry in patients who underwent correction of a complete unilateral cleft lip using the Afroze incision with and without primary septoplasty using a standardized two dimensional photographic analysis.

Methods: A prospective cohort study of 190 consecutive patients with complete unilateral cleft lip and alveolus with cleft palate treated with (n=95) or without (n=95) septoplasty using the Afroze incision technique was conducted at a high volume center. Eighty two patients operated without primary septoplasty and 76 patients operated with primary septoplasty could be evaluated. Nasal symmetry was compared between patients using a two-dimensional photographic analysis. Ratios between cleft and non cleft side for five parameters were used to assess symmetry: Alar Base (AB) to Inter Pupillary (IPP) distance, Columella Cupids Bow (CCB) distance, Nostril Gap Area, Nostril Width and Nostril Height. Mann Whitney U-test was used to calculate differences between two groups.

Results: Patients operated with primary septoplasty showed more nasal symmetry as compared to the patients operated without septoplasty. This difference was statistically significant for CCB distance, Nostril Gap Area and Nostril Height ($p=0.008$, $p<0.001$ and $p<0.001$, respectively) and for the distance between Alar Base and AB-IPP distance ($p=0.145$) the difference was present but not statistically significant. For Nostril Width, no difference was found ($p=0.850$).

Conclusion: Patients treated with primary septoplasty showed better results in terms of nasal symmetry when analyzed using two-dimensional photographic analyses.

INTRODUCTION

Despite a multiplicity of surgical approaches to its correction and as much variation in treatment philosophy, the cleft lip nasal deformity still remains a formidable challenge to the reconstructive surgeon treating patients with these congenital deformities.

Historically, correction of the cleft nose deformity had been delayed until nasal growth was complete[1]. Early surgical intervention was thought to interfere with normal growth, leading to poor long-term results[1]. Patients with cleft nose deformity had to tolerate the physical nasal deformity as well as the psychological trauma well into their adolescence[1]. Randall noted that these patients often were more concerned with their nasal deformity than with their lip deformity[2].

Refinement of rhinoplasty techniques has facilitated the ability to address the deformity associated with cleft lip[1]. Nevertheless there is still a lot of controversy regarding the best time to attempt primary surgical correction of unilateral cleft lip nasal deformity[3-5]. While a growing number of centres perform the nasal repair in conjunction with the cleft lip surgery, some go for a secondary rhinoplasty at a later stage when the cartilage is better formed[3,4]. It appears, however, that early repair results in less severe secondary deformity. As a consequence many authorities now reposition the cartilaginous nasal framework prior to age 5 or 6 years[3,4].

Ralph Latham, in 1969, proposed a hypothesis that the nasal septum was the key factor in height and anterior posterior dimensions of the face in addition to that of the nose[6]. Currently, the literature offers numerous opinions regarding the best surgical approach and timing of intervention for correction of the cleft lip nose deformity, yet consensus regarding the selection of the operative procedure, its timing, and its expected effects upon subsequent growth has not been reached[7,8].

In this study the outcome of nasal symmetry after complete unilateral cleft lip correction with primary septoplasty using the Afroze incision was compared with the outcome of nasal symmetry without primary septoplasty using the Afroze incision[9,10].

## PATIENTS AND METHODS

In this prospective cohort study 190 consecutive patients with a non-syndromic unilateral cleft of the lip and alveolus with cleft palate, presenting at a high volume cleft centre from 2003 to 2005, were included in the study. Patients below the age of 1 year were eligible for this study. The Afroze incision[9,10] without primary septoplasty (Group A) was used in 2003 and 2004, and the Afroze incision with primary septoplasty[9,10] (Group B) was used between 2004 and 2005. Each group had 95 consecutive patients operated by one single surgeon. The patients were asked to return to the clinic 2 years postoperatively to have two-dimensional pictures taken.

Approvals were sought and received from the ethical board of the hospital to apply the treatment methods for the two groups of patients.

### *Septoplasty*

All patients underwent lip repair using the Afroze technique[9,10]. This technique is a combination of the Millard advancement rotation technique on the non-cleft (medial) side and the Pfeifer incision on the cleft (lateral) side.

In the group of patients treated with primary septoplasty (Group B) the anterior nasal spine was located by subperiosteal dissection and all its attachments were separated. The septum was carefully isolated through the same incision by raising the perichondrium on both sides of the septum. The septum was detached from its attachment to the nasal spine and maxillary crest and straightened. The

perichondrium around the detached septum was sutured together with mucopericondrium and a passive non resorbable suture from the ala nasalis.M from cleft side to non cleft side in such a way that the septum was now in its central position though not resting on the anterior part of the maxilla. The nasal sill was sutured by joining the hair bearing nasal mucosa on both sides. The alar part of the nasalis muscle was then positioned below the nasal sill and attached to its counterpart on the normal side to form a sling, thereby supporting the nasal sill on the cleft side, septum and ala. After completing the repositioning of the alar part of the nasalis muscle, the orbicularis oris muscle was sutured to its counterpart and finally the skin was sutured.

*Photographic analysis*

Two different photographic views were used for analysis; a submento-vertical view and a frontal view[11]. All pictures were made by the same photographer using a standardized method. Photographs (1504 x 1000 pixels resolution) were taken with a Nikon D100 digital camera (Nikon corp., Japan). For evaluation of surgical results, measurements were taken on standardized photographs using the analysis as described by Nagy and Mommaerts, 2007[12,13]. Indirect anthropometric measurements were performed on the digital photographs processed by Photoshop 9.0 (Adobe Systems Inc, San Jose, California) with the help of Scion Image Software (National Institute of Health, Maryland, USA)[11,12].

The measurements that were done using the submento-vertical view were the nostril gap area, nostril width, and nostril height (Figure 1). These 3 measurements were done to quantify the nostril symmetry.

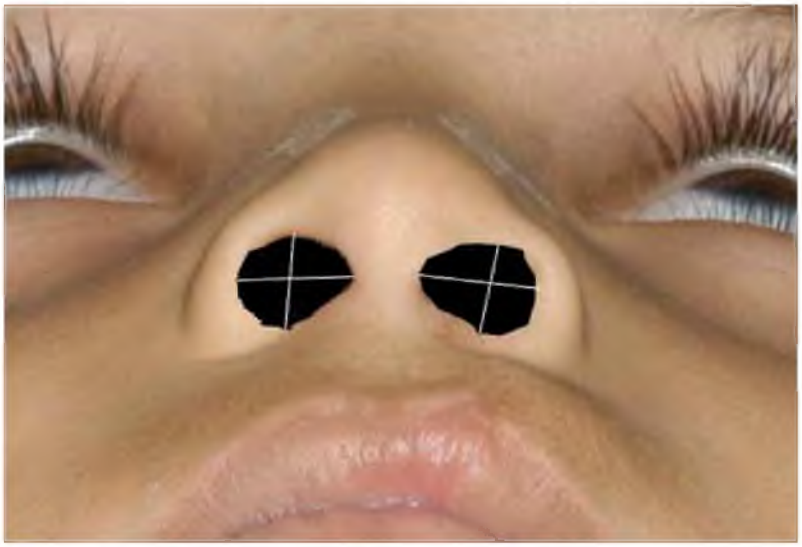

*Figure 1. Nostril gap area is measured in square millimeters using Scion software with Adobe Photoshop. Nostril width is measured in mm from the midpoint of the lateral surface of the nostril to the midpoint of the columellar surface of the nostril. Nostril height is measured from the alar base of the nostril to the mid point of the superior surface of the nostril.*

The parameters in the submento-vertical view photographs were measured using the line and angle tool for linear and angular measurements, respectively, using the Scion Image software. The area measurement were carried out with the help of magic wand tool as described by Mommaerts and Nagy[12,13].

The measurements made on the frontal view photographs were the distance from alar base to the Interpupillar line (AB-IPP), and the distance from the highest point of cupid's bow to the horizontal line crossing the columellar base parallel to the bipupillary line (CCB) (Fig 2).

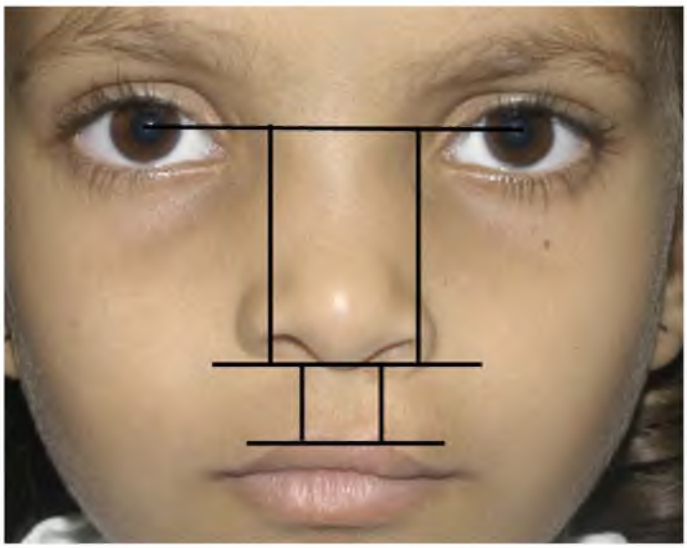

*Figure 2. AB IPP distance is measured perpendicularly from the alar base to the interpupillary line on the left and right side. CCB distance id measured from the highest point on the cupid's bow left and right to the horizontal line crossing columellar base parallel to the bipupillary line on the left and right side.*

For all five parameters, the values on the cleft side were divided by the values on the non cleft side. A ratio of 1 indicated perfect symmetry, and any deviation from 1 was a measure of asymmetry. However, since a ratio of 4/3 is essentially the same as a ratio of 3/4, the difference between the ratio and 1 is not a good expression of asymmetry. Therefore the final asymmetry score ratio will be (ratio – 1) for ratios greater than 1, and ((1/ratio) – 1) for ratios smaller than 1. Throughout this article the asymmetry scored is expressed as a percentage. For the five ratios standard descriptive statistics are used. The five asymmetry scores are presented descriptively using a five point scale (asymmetry <0.5%, 0.5% or larger but lower than 5%, 5% or higher but lower than 10%, 10% or higher but lower than 15%, or 15% or higher). Since the asymmetry scores have a skew and irregular distribution, non parametric statistics were required for statistical testing. Therefore, statistical differences between the two groups were analysed using the Mann Whitney-U test.

All measurements were done by two observers (SGR, RRR), each scoring 50% of the experimental and 50% of the control group. To assess observer performance 20 randomly selected cases were scored by both observers. Observer performance was analysed using the reliability score (calculated as Pearson's correlation) and the duplicate measurement error. Additionally the paired T-test was applied to test for statistically significant differences between both the observers. All statistical analyses were performed using SPSS 16.0.

## RESULTS

### *Patient groups*

All patients enrolled in both groups were recalled after two years. Of the 95 patients enrolled in group A 82 returned for evaluation (13.69% lost to follow-up) while in group B 76 patients returned (20% lost to follow-up). Group A consisted of 82 patients of which 55 were left sided clefts (19 female, 36 male) and 27 were right sided clefts (12 female, 15 male). Group B consisted of 76 patients of which 55 were left sided clefts (23 female, 32 male) and 21 right sided clefts (9 female, 12 male).

In this study patients with cleft lip and alveolus with cleft palate were included.

### *Reliability*

In Table 1, the results of the interobserver analysis are summarized. The reliability scores were all above 0.7 except for a relatively low score for Nostril Height at the non cleft side, with a reliability of 0.563. The duplicate measurement errors ranged between 0.107 mm and 0.294 mm. No statistical significant differences between the two observers for the 10 distances measured were found (P values are 0.099 or higher).

| Parameter | DME | Relia-bility | Difference between observers | | |
|---|---|---|---|---|---|
| | | | Mean difference | p-value | 95% CI for difference |
| AB IPP Cleft side | 0.16 | 0.986 | 0.010 | 0.852 | [-0.096-0.115] |
| AB IPP Non cleft side | 0.18 | 0.982 | -0.019 | 0.743 | [-0.138-0.100] |
| CCB Cleft side | 0.18 | 0.866 | 0.084 | 0.164 | [-0.038-0.206] |
| CCB Non cleft side | 0.25 | 0.722 | 0.079 | 0.320 | [-0.083-0.242] |
| Nostril Gap Area Cleft side | 0.11 | 0.993 | 0.040 | 0.251 | [-0.031-0.111] |
| Nostril Gap Area Non cleft side | 0.16 | 0.984 | -0.080 | 0.129 | [-0.184-0.025] |
| Nostril Width Cleft side | 0.29 | 0.757 | -0.058 | 0.543 | [-0.252-0.137] |
| Nostril Width Non cleft side | 0.22 | 0.821 | 0.120 | 0.099 | [-0.025-0.264] |
| Nostril Height Cleft side | 0.14 | 0.822 | -0.001 | 0.983 | [-0.096-0.094] |
| Nostril Height Non cleft side | 0.24 | 0.563 | -0.083 | 0.293 | [-0.244-0.078] |

*Table 1. Inter observer performance. Duplicate measurement errors (DME) and differences are expressed in mm and sq. mm.*

*Nasal scores*

In Table 2 the descriptive statistics for the five ratios are depicted. For both groups nostril height shows the largest asymmetry of all variables.

| Group | Ratio Cleft / Non Cleft | Min. | Max. | Mean | SD |
|---|---|---|---|---|---|
| **Without septoplasty** (N=82) | AB IPP distance | 0.91 | 1.09 | 0.99 | 0.04 |
| | CCB distance | 0.83 | 1.83 | 1.12 | 0.15 |
| | Nostril Gap Area | 0.26 | 2.74 | 1.28 | 0.40 |
| | Nostril Width | 0.56 | 1.85 | 0.94 | 0.21 |
| | Nostril Height | 0.90 | 6.47 | 1.65 | 0.76 |
| **With septoplasty** (N=76) | AB IPP distance | 0.87 | 1.11 | 1.00 | 0.04 |
| | CCB distance | 0.88 | 1.79 | 1.07 | 0.14 |
| | Nostril Gap Area | 0.70 | 1.95 | 1.06 | 0.22 |
| | Nostril Width | 0.56 | 1.55 | 0.90 | 0.19 |
| | Nostril Height | 0.72 | 3.44 | 1.31 | 0.40 |

*Table 2.Descriptive statistics per treatment group. Asymmetry is expressed as a ratio (for each parameter the cleft side value is divided by the non-cleft side value).*

Table 3 depicts the distribution of the cases over the various levels of asymmetry for the five parameters. This table shows that considerable differences can be seen when comparing the five parameters. For instance for the AB-IPP distance in both groups the large majority of cases have less than 5% asymmetry, whereas for Nostril Height the majority of the cases have over 15% of asymmetry.

| Parameter | | Level of asymmetry | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Septoplasty group | *None* | | *<5%* | | *5-10%* | | *10-15%* | | *>15%* | |
| *AB IPP distance* | Without | 6 | -7.30% | 56 | -68.30% | 20 | -24.0% | 0 | 0.00% | 0 | 0.00% |
| | With | 14 | -18.40% | 51 | -67.10% | 9 | -11.80% | 1 | -1.30% | 1 | -1.30% |
| *CCB distance* | Without | 7 | -8.50% | 15 | -18.30% | 15 | -18.30% | 12 | -14.60% | 33 | -40.20% |
| | With | 13 | -17.10% | 20 | -26.30% | 16 | -21.10% | 12 | -15.80% | 15 | -19.70% |
| *Nostril Gap Area* | Without | 2 | -2.40% | 8 | -9.80% | 6 | -7.30% | 11 | -13.40% | 55 | -67.10% |
| | With | 2 | -2.60% | 26 | -34.20% | 12 | -15.80% | 11 | -14.50% | 25 | -32.90% |
| *Nostril Width* | Without | 5 | -6.10% | 10 | -12.20% | 13 | -15.90% | 15 | -18.30% | 39 | -47.60% |
| | With | 2 | -2.60% | 11 | -14.50% | 13 | -17.10% | 10 | -13.20% | 40 | -52.60% |
| *Nostril Height* | Without | 1 | -1.20% | 1 | -1.20% | 7 | -8.50% | 2 | -2.40% | 71 | -86.60% |
| | With | 1 | -1.30% | 11 | -14.50% | 15 | -19.70% | 5 | -6.60% | 44 | -57.90% |

*Table 3. Cross tables between treatment group and levels of asymmetry. Number and percentage of patients for each level of asymmetry are given. Asymmetry is expressed as a ratio (for each parameter the cleft side value is divided by the non-cleft side value). The asymmetry scores are represented by a five point scale (asymmetry <0.5%, 0.5% or larger but lower than 5%, 5% or higher but lower than 10%, 10% or higher but lower than 15%, or 15% or higher).*

Table 4 shows the results of the Mann Whitney U-tests to statistically test whether the two treatment groups were different regarding asymmetry for the five parameters. For three parameters, CCB, Nostril Gap Area and Nostril Height, the group treated using a septoplasty showed statistically significant lower asymmetry scores. For the AB-IPP, there was a tendency for a better symmetry in the group with septoplasty but the p value of 0.145 did not reach significance. For the last parameter, Nostril Width, the p value was very high (P=0.850) which gives no indication of either group to show better results.

| Parameter | p-value | group with lowest asymmetry |
|---|---|---|
| *AB IPP distance* | 0.145 | with septoplasty |
| *CCB distance* | **0.008** | **with septoplasty** |
| *Nostril Gap Area* | **<0.001** | **with septoplasty** |
| *Nostril Width* | 0.850 | without septoplasty |
| *Nostril Height* | **<0.001** | **with septoplasty** |

*Table 4. Results of Mann Whitney U-test comparing the two treatment groups. Statistically significant differences are printed in bold face.*

DISCUSSION

Unilateral cleft lip nasal deformity is characterized by a prominent asymmetry resulting from distorted and displaced structures[6]. It consists of a depressed cleft side dome and splayed ala[14-16]. The cleft side alar base is also depressed and frequently vertically elevated; at the same time, the alar rim is everted exposing the nasal lining[14-16]. The septum is pulled to the non-cleft side along with the premaxilla by the muscle imbalance[14-16]. The nasal dorsum is deviated towards the non-cleft side[14-16]. These nasal deformities are further compounded by the skeletal base malposition on the cleft side[14,16,17]. Primary correction of the nasal deformity

at the same time of lip repair has, therefore, gained popularity, aimed at early restoration of the symmetry by lifting the alar cartilage and lengthening the columella on the cleft side[6,17,18]. Functional and aesthetic results have proven to be very gratifying and long lasting[1].

The theory of septal repositioning during primary cheiloplasty procedure is based on the premise that most fibres of the alar part of the nasalis muscle and deep bundles of orbicularis oris insert to the mucoperichondrium and anterior nasal septum in unilateral cleft lip patients. Correction of the deviated septum is important because it provides stability and exact positioning of the previously lifted alar cartilage of the cleft side and nasal tip. As a consequence the nose can grow in a balanced way with equal muscular force being exerted on both sides[9,18,19]. Studies have demonstrated that no negative sequel can be observed after manipulation of the septum in children[19,20]. Smahel et al. (1998) studied the effect of primary septum repositioning on facial growth using roentgenocephalometrics and concluded that patients with primary repositioning of the nasal septum had a more favourable nasal prominence and better vertical growth of the upper and whole face in the posterior third[8,21]. If no primary correction is performed, nasal breathing problems persist until late corrections are made[9,14].

Objective evaluation of the nasal form and symmetry in cleft patients is difficult. Mommaerts and Nagy developed a computer analysis for nasal form and symmetry (intranasal symmetry and symmetrical position of the nose) in order to evaluate primary and secondary cleft rhinoplasty outcomes[12]. This nasal analysis has proven to be appropriate for comparing results of different surgical techniques in which indirect anthropometric measurements were performed on digital photographs with the Scion Image Software[11-13]. In the present study, this method was used. One of the disadvantages of indirect measurements on pictures is the difficulty to standardize the way of taking the photographs, because it is hard to take

photographs from a standardized distance with the head of the child in a standardized position[12]. To bypass these problems only ratios between cleft and non-cleft sides were used and not absolute distances. The interobserver analysis showed good performance characteristics and the reliability was comparable to the values described in the original paper on this method[12] except for the reliability of the Nostril Gap Area on the non cleft side. This is most likely caused by a far smaller variability of the values measured at the non cleft side, which makes achieving a high reliability more difficult. Since a statistically significant difference was found between the control and the experimental group regarding the Nostril Gap Area, observer performance was not hampered by this relatively low reliability.

In 2004, Kim et al. compared the results of primary correction of cleft lip using conventional methods and cases operated with simultaneous rhinoplasty using photographs and anthropometric evaluation[22]. In cases of simultaneous repair, nasal tip projection and columellar length were increased by 24.8 percent and 28.8 percent respectively. Nasal width was increased by 12.3 percent in the cases of simultaneous repair and 12.6 percent in the cases without primary rhinoplasty. The difference of postoperative anthropometric measurement between patients receiving primary nasal correction and normal children was not significant[22].

In this study, we have attempted to correct the mal-positioned architecture of the nose through a morpho-functional repair of the nasal septum and repositioning of the alar nasalis muscle without correcting the other parts of the nose.

The results of the present study support the opinion of advantages of primary septoplasty since the nostril of the cleft side showed better symmetry in the group treated with septoplasty. The ratios of the patients operated with septoplasty were much closer to 1 in comparison to the ratios of those operated without septoplasty for three of the five parameters namely CCB distance, Nostril Gap Area and Nostril

Height, thus indicating that a better (near normal) symmetry of nose and lip segment could be achieved for cases operated with primary septoplasty. Although on average the ratios are relatively close to the perfect value of 1, especially in the group operated with primary septoplasty, this average is the sum of cases with ratios less than 1 and larger than 1. The average ratio is not suitable to compare the two groups, because ratios greater than 1 and less than 1 nullify each other, while both indicate a lack of symmetry. Therefore to statistically test the findings Mann Whitney U-tests were used.

In this study, ratios were used when comparing results of two surgical techniques to eliminate observation bias caused by differences in imaging and imaging techniques. Farkas and Lindsay (1971) used direct anthropometric analysis[23]. Direct anthropometric analysis is accurate and well-accepted by anthropologists, but it is very difficult to reproduce, especially when large numbers of patients are involved and by direct measurement no record is available for later (re)evaluation[23,24]. Indirect anthropometry eliminates such drawbacks. However, any photograph is a two-dimensional image of a three-dimensional structure. Thus, it was extremely important to take pictures in the proper position and to avoid any transverse rotation of the face which could result in misleading projections of facial structures on the pictures. Therefore, for future studies a three- dimensional analysis of nasal form would be a much better tool for assessing such symmetries with an improved precision.

This study cannot answer the question whether undisturbed growth of the nose will occur in the long run. The patients were between 3 and 4 years of age at the time of follow-up. Nasal development needs to be re-evaluated in both groups after growth has ceased.

## CONCLUSION

The results of the present study and an intensive survey of the literature lead to a conclusion that a significant difference in terms of nasal symmetry and alar height symmetry could be found in patients treated with primary septoplasty in comparison with those treated without septoplasty. The symmetrical outcomes were much better in patients treated with septoplasty when assessed by the two dimensional photographic analysis.

The final outcome of nasal deformity awaits a follow-up period of many more years to profoundly evaluate the influence on nasal growth and outcome. Thus, a study with a longer follow-up is required to comment on the superiority of one method over the other.

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# CHAPTER 10

# General Discussion and Overview

## INTRODUCTION

This thesis attempts to understand the intricacies of unilateral cleft lip defects. There are primarily two reasons why I chose to study the unilateral cleft defect. Firstly, the unilateral defect is a unique defect of the human face where the defect is not placed in the midline but on one side of the face. This causes a great challenge for the surgeon to treat the cleft because he/she has to constantly compare the result of the surgery to that of the non affected side. This comparison will also be done by the patient's friends, colleagues and most importantly by the patient him/herself. The second reason is that the unilateral cleft defect, involves not only the lip but also the nose and maxilla, which makes it a multidimensional high demanding surgical challenge. The disturbance of important anatomical landmarks is a major cause of stigma for the patient even after he/she is operated on for a cleft. In this way, the aim of this thesis can only be an attempt to improve surgical techniques to overcome this stigmata.

## STRENGTHS AND WEAKNESSES OF THE STUDY

The major strength of this study is the sheer number of patients available and willing to participate. Our hospital treats at least 400 patients with unilateral cleft lips every year. Such a number of patients in a year ensured that we could complete various aspects of this study in a relatively short time. However, this strength is sometimes a weakness because adequately following up on such a large number of patients is difficult in a developing country like India. Most of the patients included in the various studies in this thesis are from very low socio-economic backgrounds who subsist on daily wages. Repeated follow up visits are not economically viable for them. Therefore we had to devise a variety of methods to improve follow up rates that included giving them incentives for keeping appointments, arranging to meet them in or near their hometowns and arranging to transport them from their homes to the hospital free of cost.

The most important surgical drawback of this study may be that the authors were trained and exposed to the original technique of R. Millard and in this way, the value of the subsequent modifications of Millards techniques were not involved in the analysis.

Another drawback of this thesis is that most of the publications are retrospective studies, since the primary aim of our work previously was to treat large numbers of patients with cleft defects. My team and I have done more than 16,000 cleft surgeries since 1996. Such a large number of patients usually leaves little time for clinicians like me to initiate well organized research. However, during the course of this thesis I was able to shift from retrospective into prospective studies.

Besides organizational aspects there are also financial limitations. Using resources for research when many patients are waiting for treatment would seem harsh to the patients who would feel that they were denied surgery because of a lack of funds. This situation has changed over the past five years with the back log of patients with cleft defects being almost completely removed. Research on patients with cleft and craniofacial defects has therefore now become as much a priority as treating patients.

Funding for surgery was received from Hermann Sailer's Swiss Cleft Center, Zurich, Switzerland and funding for research was received from the Department of Oral and MaxilloFacial Surgery, Radboud University Nijmegen Medical Center, Nijmegen, The Netherlands.

After having been successful in surgical organization and the research funding, I now do have the valencies to organize research projects in my department, so inspiring other colleagues to start projects of their own.

DESIGN OF THE STUDY

The thesis was designed in such a way that the reader would get a complete perspective of the problem of cleft lip defects in the state of Andhra Pradesh, India. I first started by studying the incidence of cleft defects (Chapter 2) and setting up

rehabilitation of cleft defects in the region I worked in (Chapter 3). While establishing a centre, I found that patients with clefts also had other anomalies associated with the defect. I decided to study this problem so as to incorporate a protocol to comprehensively treat cleft defects and their associated problems (Chapter 4). I also studied the Quality of Life of a cleft patient after all the treatment is completed (Chapter 5). I found a very interesting fact during the study. Patients with unilateral cleft lips have to deal with a worse quality of life compared to the patients with bilateral cleft lips. This was most probably due to the asymmetry of the facial features. As a consequence I decided to concentrate on the unilateral cleft defects. After having studied and compared two standardized techniques to repair unilateral clefts (Chapter 6), I designed a variant incision for treating unilateral cleft lip defects (Chapter 7). After having compared the new incision to the ones I used previously (Chapter 8) I also studied the outcomes of various methods that we used in treating cleft lip (Chapter 9).

INCIDENCE

According to the study done at our center, the incidence of cleft defects in Andhra Pradesh, India was found to be 1.09 per 100 live births (1800 live cleft births in one year). Most studies done on incidence of unilateral cleft defects show that in a given cleft population the incidence of unilateral cleft lip defects is predominantly higher[1,2]. We found 79% of the cleft lip defects were unilateral in nature. It is also widely accepted that left sided unilateral clefts are more common than right sided unilateral cleft lips[3,4] which is supported by our study. Of the unilateral cleft lips in our study, 64% of were left sided.

The widespread incidence of cleft defects in the state of Andhra Pradesh inspired me to set up services to rehabilitate children born with such defects. I visited different cleft units around Europe and the U.S.A. in an effort not only to learn how to treat clefts but also how to set up rehabilitation services for patients with cleft defects. This led to a formation of partnerships of excellence with 7 universities* in

Europe and USA that helped me to set up infrastructure, equipment and a team to deliver comprehensive treatment for patients with cleft and craniofacial defects.

## STANDARDIZING AND DEVELOPING A CLEFT CENTER IN HYDERABAD, INDIA

It was now clear that I had to establish a treatment facility to spread awareness about this devastating defect, treat it and standardize the process of awareness and treatment so that patients with clefts could significantly improve their nutritional status as well as their quality of life. This was achieved by establishing a cleft center in Hyderabad that catered to a population of approximately 70 million people over a radius of 1000 kilometers. Awareness programs were standardized to tell people about the problem of clefts and its treatment. A hospital was set up to rehabilitate patients completely by giving services like surgery, speech therapy, orthodontics, psychological counseling and constructing self help groups. A school was also established for these children so that they could participate in society rather than be on its periphery. Training was also given to different professionals involved in cleft care to improve the services.

## QUALITY OF LIFE

Before I chose the topic of unilateral cleft lip repair for this thesis, I did a study to assess the Quality of Life of cleft patients in general. The most interesting observation in this study was that patients with bilateral cleft lips perceived a better quality of life when compared to patients with unilateral cleft lips.

This study justified my belief that the unilateral cleft lip repair is more challenging than the bilateral cleft repair because the patient usually compares the result of the treatment on the affected side with that of the unaffected side. I therefore decided that our center needed to improve the surgical techniques to treat unilateral cleft defects.

## SURGICAL ASPECTS FOR TREATMENT OF UNILATERAL CLEFT LIP

The principal surgical goal for the treatment of unilateral cleft lips in my center was to have a treatment method that addressed the main problems of the cleft lip in only one surgery. Within the field of my surgical interest, I studied the technical aspects of cleft lip surgery on one hand and particularly assessed interest to the surgical aspect of the septum on the other hand.

With regard to the lip, I first compared two standardized techniques (Millard and Pfeifer). I then combined the advantages of both the techniques to evolve into the Afroze incision which I then compared to the previous two techniques. With regard to the septum I studied the advantages and disadvantages of cheiloplasty with and without septoplasty.

## AFROZE INCISION

The Afroze incision was developed as a simple incision to provide a single step correction of the unilateral cleft lip irrespective of the width of the cleft or the tissue present lateral to the cleft.

Initially I used and propagated the Millard's incision for unilateral cleft lip repair with Delaire philosophy to repair the muscles and mucosa. This technique was what I was trained to do. I used this incision for more than 1000 patients. In 2001, I was introduced to the Pfeifer incision. I used this for two years treating more than 600 patients. Then a surgical technician who had worked for me for seven years and had assisted me for almost all the cleft surgeries that I did, came to me with the idea of combining the two incisions such that the advantages of Millard and Pfeifer incisions could be optimized. Since it was designed by Afroze, the technician, we decided to call it the Afroze incision.

The Afroze incision[5] design addresses the problem of downward rotation of the cupids bow on the non-cleft side and lengthening of the lip on the cleft side respectively. The Pfeifer's incision on the cleft side also ensures easy access to the m. alar nasalis below.

To compare the efficiency of the Afroze incision it was compared to the Millard and Pfeifer incision. 1200 patients divided into 3 cohorts, with each cohort treated with Millard incision, Pfeifer incision or Afroze incision were studied.

The Afroze incision performed statistically significantly better than Millard and Pfeifer for 6 of the 8 parameters, i.e. White Roll Match, Vermillion Match, Scar appearance, Cupids bow, Lip Length and Nostril Symmetry. With regard to Alar Dome and Base, Afroze did not perform statistically significantly better than Millard and Pfeifer incisions. This proved that the Afroze incision was a good technique for the repair of unilateral cleft lip defects.

The Afroze incision is now used as a standard practice to repair unilateral cleft lips in our center.

PRIMARY SEPTOPLASTY

Unilateral cleft lip nasal deformities are characterized by prominent asymmetry resulting from distorted and displaced structures[6]. It consists of a depressed cleft side dome and splayed ala. The cleft side alar base is also depressed and frequently vertically elevated; at the same time, the alar rim is everted exposing the nasal lining[7-9]. The septum is pulled to the non-cleft side along with the premaxilla by the muscle imbalance. The nasal dorsum is deviated towards the non-cleft side[7-9]. These nasal deformities are further compounded by the skeletal base malposition on the cleft side.

There are proponents and opponents of early nose repair[10]. Randall noted that patients often were more concerned with their nasal deformity than with their lip deformity[11]. It appears, however, that early repair results in less severe secondary deformity, and many authorities now reposition the cartilaginous nasal framework prior to age 5 or 6 years[12,13]. Primary correction of the nasal deformity at the same time of lip repair has gained popularity, aimed at early restoration of the symmetry by lifting the alar cartilage and lengthening the columella on the cleft side[6].

Within the rhinoplasty procedures, septoplasty always plays an important role. Ralph Latham, in 1969, proposed a hypothesis that the nasal septum was the key factor in height and anterior posterior dimensions of the face in addition to that of the nose[14]. Based on the evidence provided by literature on one hand and with the Latham-hypothesis in mind on the other hand, I started doing primary cheiloseptoplasty to correct the problem of the alar cartilages and septal deviation. To validate my method of primary septoplasty I compared the results with patients who did not have primary septoplasty. The results of the 2-D photography study indicated that the nostril of the cleft side showed better symmetry in the group treated with septoplasty (significant for Columella-Cupids Bow distance, Nostril Gap Area and Nostril Height, Alar Base Inter Pupillary distance' but not significant for Nostril Width).

PROTOCOL

The conclusions of all these studies are now included to finally end up with a surgical protocol that is actually used as a standard in our center.

Based upon the research of this thesis, our protocol for repairing unilateral cleft lips now includes primary lip repair using the Afroze incision, functional repositioning of all muscles of the lip and nose including m. orbicularis oris and m. alar nasalis, primary septoplasty as well as perioplasty. We call this technique the "Afroze Primary Cheiloseptoplasty".

After completing various studies to validate the efficacy of this technique, we firmly believe that Afroze Primary Cheiloseptoplasty is the gold standard for treating unilateral cleft defects in our center.

FURTHER RESEARCH

Though incidence, treatment options and outcome measurement for unilateral cleft lips have been extensively discussed in this thesis, there is also a great need to find additional information about the causes of cleft formation. At present, global

research includes the identification of some genes that might be the cause of cleft formation, though this research is not conclusive. There is also an attempt to link cleft formation with environmental factors. Though some research has found increased risk of cleft formation in relation to certain substances with pregnant mothers, conclusive data is still elusive. A high volume center as ours offers great opportunities in this field.

Another area of interest for this cleft related research is the measuring of outcomes using 3D stereo-photogrammetry. An attempt was made to include such a study in thesis but due to technical difficulties it was not possible, though there was some breakthrough in finding a protocol to do such a study. A publication to include this 3D research is in preparation.

A study to see the difference in Quality of Life of patients who have undergone Afroze Primary Cheiloseptoplasty will probably give a positive conclusion to the efficacy of this technique.

Improving quality of life of patients with clefts also means that there should be more emphasis on peripheral rehabilitation like education, counseling and employment opportunities. I hope cleft teams around the world make efforts to employ more patients with clefts and train them to care for future generations of cleft patients.

My hope for this thesis is that all professionals involved in the field of cleft care will accept it, thereby making treatment of unilateral cleft lips easier and more efficient.

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# HOOFDSTUK 11

# Algemene discussie en overzicht

## INLEIDING

Dit proefschrift heeft tot doel inzicht te verschaffen in de problemen die gepaard gaan met enkelzijdige schisis. Ik heb voor dit onderwerp gekozen om twee redenen. Ten eerste omdat enkelzijdige schisis een unieke afwijking van het menselijk gelaat is die niet in het midden van het gezicht optreedt, maar aan één zijde ervan. Het verhelpen van deze afwijking door middel van chirurgie is een zeer uitdagend, maar gecompliceerd procedé, omdat de chirurg het resultaat van iedere ingreep moet vergelijken met de normale kant van het gezicht van de patiënt. Deze vergelijking wordt natuurlijk ook door vrienden en collega's van de patiënt, en belangrijker nog, door de patiënt zelf, gemaakt. De tweede reden waarom ik voor dit onderwerp heb gekozen is dat enkelzijdige schisis niet alleen een afwijking van de lip is, maar ook van de neus en de bovenkaak, waardoor er bij de chirurgische behandeling met erg veel factoren rekening moet worden gehouden. De verstoring van belangrijke anatomische kenmerken ervaart de patiënt als een stigma, zelfs na een geslaagde operatie. Hopelijk kan dit proefschrift bijdragen aan een zodanige verbetering van de chirurgische technieken dat patiënten niet langer met dit stigma door het leven hoeven te gaan.

## STERKE EN ZWAKKE PUNTEN

Het grote aantal patiënten dat beschikbaar en bereid was deel te nemen vormt het sterkste punt van deze studie. Ons ziekenhuis behandelt jaarlijks minstens 400 patiënten met enkelzijdige schisis. Door dit grote aantal patiënten waren wij ervan verzekerd dat we verschillende aspecten van deze studie in een relatief korte periode zouden kunnen afronden. Soms kan een grote onderzoekspopulatie echter ook een zwak punt vormen, omdat het adequaat volgen van zoveel patiënten nogal moeilijk is, vooral in een ontwikkelingsland als India. De meeste patiënten betrokken bij de verschillende studies beschreven in dit proefschrift komen uit zeer zwakke sociaaleconomische milieus en houden zich in leven door te werken als dagloners. Regelmatige consultatie was voor hen financieel niet haalbaar. Daarom

moesten we verschillende methoden bedenken om hen te kunnen blijven volgen, bijvoorbeeld door hen te belonen als ze zich aan de afspraken hielden, hen zelf op te zoeken of gratis vervoer van en naar het ziekenhuis te regelen.

Een ander minpunt is dat de meeste publicaties retrospectieve studies zijn, aangezien voorheen de behandeling van grote aantallen patiënten met schisis het voornaamste doel van ons werk was. Sinds 1996 heeft mijn team meer dan 16.000 schisisoperaties uitgevoerd. Met zoveel patiënten hebben clinici zoals ik meestal weinig tijd over om een goed opgezet onderzoek op te starten. Naarmate dit proefschrift vorderde, kon ik echter overschakelen van retrospectieve naar prospectieve studies.

Naast organisatorische aspecten waren er ook financiële beperkingen. Ik kon moeilijk de beschikbare middelen gebruiken voor onderzoek terwijl veel patiënten wachtten op behandeling. Dat zou op hen nogal cru overkomen en zou hen het gevoel hebben kunnen geven dat hen behandeling werd onthouden vanwege gebrek aan middelen. In de afgelopen vijf jaar is deze situatie veranderd doordat de wachtlijst met patiënten met schisis bijna geheel is weggewerkt. Onderzoek onder de populatie van patiënten met schisis en craniofaciale afwijkingen heeft daarom nu net zoveel prioriteit als de behandeling van deze patiënten.

De operaties werden gefinancierd door het Swiss Cleft Centre opgezet door Hermann Sailer in Zürich en het onderzoek door de afdeling Mond- en Kaakchirurgie van het Universitair Medisch Centrum St Radboud in Nijmegen.

Na de succesvolle organisatie van onze chirurgieafdeling en verwerving van onderzoekssubsidies, ben ik nu bij machte onderzoeksprojecten op mijn afdeling te organiseren, en zo mijn collega's te inspireren tot het opzetten van eigen projecten.

## OPZET VAN DE STUDIE

Het proefschrift is zodanig gestructureerd dat de lezer een compleet beeld krijgt van het schisisprobleem in de staat Andhra Pradesh in India. Ik ben begonnen met

de bestudering van de incidentie van schisis (hoofdstuk 2) en de organisatie van de behandeling voor schisispatiënten in de regio waarin ik werk (hoofdstuk 3). Bij het opzetten van het centrum bemerkte ik dat patiënten met schisis ook andere aan schisis gerelateerde afwijkingen vertoonden. Ik besloot daarop dit probleem te bestuderen ten einde een protocol te kunnen opstellen voor een complete behandeling van schisis en de daaraan gerelateerde problemen (hoofdstuk 4). Ik heb tevens de kwaliteit van leven van de behandelde schisispatiënten bestudeerd (hoofdstuk 5). Tijdens de studie deed ik een belangrijke ontdekking. De kwaliteit van leven van patiënten met enkelzijdige schisis is slechter dan die van patiënten met dubbelzijdige schisis. Dit had waarschijnlijk te maken met de asymmetrie van het gelaat. Dat is de reden waarom ik mij volledig ben gaan richten op enkelzijdige schisis. Nadat ik twee gestandaardiseerde technieken voor de chirurgische behandeling van enkelzijdige schisis had bestudeerd en vergeleken (hoofdstuk 6), ontwikkelde ik een variant op de incisie waarmee enkelzijdige schisis wordt verholpen (hoofdstuk 7). Nadat ik de nieuwe incisie had vergeleken met de andere die ik voorheen had gebruikt (hoofdstuk 8), heb ik eveneens de resultaten bestudeerd van de verschillende methoden die we gebruikten voor de behandeling van schisis (hoofdstuk 9).

INCIDENTIE

De studie die ik heb verricht in ons centrum laat zien dat de incidentie van schisisgevallen in Andhra Pradesh op 1,09 per 100 levend geboren kinderen ligt (1800 levend geboren kinderen met schisis in een jaar). De meeste studies naar incidentie van enkelzijdige schisis laten zien dat enkelzijdige schisis vaker voorkomt in een gegeven patiëntenpopulatie dan dubbelzijdige schisis [1,2]. In onze populatie ging het bij 79% van de schisisgevallen om enkelzijdige schisis. In het algemeen wordt ook aangenomen dat linkszijdige schisis vaker voorkomt dan rechtszijdige schisis[3,4], hetgeen door onze studie wordt bevestigd. Bij 64% van de enkelzijdige schisisgevallen in onze studie betrof het linkszijdige schisis.

Omdat de incidentie van schisis zo hoog was in de staat Andhra Pradesh besloot ik behandelcentra op te gaan zetten voor kinderen met deze aangeboren afwijking. Ik bezocht verschillende chirurgische afdelingen in Europa en de V.S., niet alleen om meer te weten te komen over de behandeling van schisis, maar ook om te leren hoe ik het beste een schisiscentrum kon opzetten. Dit leidde tot de vorming van kennispartnerschappen met 7 universiteiten* in Europa en de V.S. die mij hielpen bij het opzetten van de infrastructuur, de uitrusting en een team voor uitgebreide behandeling van patiënten met schisis en craniofaciale afwijkingen.

STANDAARDISERING EN OPRICHTING VAN EEN SCHISISCENTRUM IN HYDERABAD (INDIA)

Wat mij vervolgens voor ogen stond was de oprichting van een behandelfaciliteit om de mensen kennis over deze afwijking bij te brengen, om de patiënten te kunnen behandelen en om deze bewustmakings- en behandelingsprocessen te kunnen standaardiseren, en zo een aanzienlijke verbetering tot stand te brengen in de voedingstoestand en kwaliteit van leven van schisispatiënten. Dit doel werd verwezenlijkt met de oprichting van een schisiscentrum in Hyderabad, met een verzorgingsgebied met een straal van 1000 kilometer bevolkt door ongeveer 70 miljoen mensen. Door middel van gestandaardiseerde voorlichtingsprogramma's werden de mensen geïnformeerd over schisis en de behandeling ervan. Er werd een ziekenhuis opgezet voor de volledige behandeling van patiënten met behulp van o.a. chirurgie, logopedie, orthodontie, psychologische hulpverlening en zelfhulpgroepen.

Er werd eveneens een school opgericht voor deze kinderen, zodat ze aan de maatschappij konden deelnemen en niet aan de zelfkant ervan zouden geraken. Om de dienstverlening te verbeteren werden er trainingen verzorgd voor verschillende professionals betrokken bij de zorg voor schisispatiënten.

## KWALITEIT VAN LEVEN

Voordat ik begon aan dit proefschrift over enkelzijdige schisis heb ik een studie verricht naar de kwaliteit van leven van schisispatiënten in het algemeen. De interessantste observatie in deze studie was dat, vergeleken met patiënten met enkelzijdige schisis, patiënten met dubbelzijdige schisis een betere kwaliteit van leven ervoeren.

Deze studie rechtvaardigt mijn overtuiging dat de chirurgische behandeling van enkelzijdige schisis een grotere uitdaging vormt voor de chirurg dan die van dubbelzijdige schisis, omdat de patiënt het resultaat van de behandeling aan de aangedane zijde gewoonlijk vergelijkt met de niet-aangedane zijde. Daarom besloot ik dat ons centrum betere chirurgische technieken diende te ontwikkelen voor de behandeling van enkelzijdige schisis.

## CHIRURGISCHE ASPECTEN VAN DE BEHANDELING VAN ENKELZIJDIGE SCHISIS

Ons belangrijkste doel was het vinden van een chirurgische behandelmethode waarmee de grootste problemen met een enkele operatie konden worden verholpen. Binnen het kader van mijn vakgebied bestudeerde ik enerzijds de technische aspecten van schisischirurgie en anderzijds had ik vooral interesse voor de chirurgische aspecten van de correctie van het neustussenschot.

Met betrekking tot lipcorrectie heb ik eerst twee gestandaardiseerde technieken bestudeerd (Millard en Pfeifer). Vervolgens heb ik de voordelen van beide technieken gecombineerd in de Afroze-techniek en heb ik deze techniek vergeleken met de twee eerder genoemde technieken. Met betrekking tot het neustussenschot heb ik de voor- en nadelen van cheiloplastiek met en zonder septoplastiek onderzocht.

AFROZE-TECHNIEK

De Afroze-techniek bestaat uit een eenvoudige incisie waarmee in één stap een enkelzijdige schisis kan worden gecorrigeerd, ongeacht de breedte van de spleet en het weefsel aanwezig ter zijde van de spleet.

Aanvankelijk gebruikte en propageerde ik de lipsluiting volgens Millard en Delaire voor het herstellen van de spieren en het slijmvlies. Deze techniek had ik geleerd tijdens mijn opleiding. Ik gebruikte deze incisie bij meer dan 1000 patiënten. In 2001 leerde ik de methode van Pfeifer kennen. Met deze techniek heb ik in twee jaar meer dan 600 patiënten behandeld. Toen kwam een medisch technicus met wie ik zeven jaar had gewerkt en die me had geassisteerd bij bijna al mijn schisisoperaties met het idee om de twee incisietechnieken te combineren zodat de voordelen van beide kon worden geoptimaliseerd. Aangezien deze nieuwe techniek het idee was van deze technicus, Afroze genaamd, besloten we deze incisie de Afroze-techniek te noemen.

De Afroze-techniek[5] biedt een oplossing voor het probleem van de neerwaartse rotatie van de cupidoboog aan de niet-aangedane zijde en uitrekking van de lip aan de aangedane zijde. Daarnaast zorgt de Pfeifer-incisie aan de aangedane zijde voor een gemakkelijke toegang tot het alaire deel van de m. nasalis.

Om de effectiviteit van de Afroze-techniek te kunnen beoordelen werd de techniek vergeleken met de lipsluiting volgens Millard en Pfeifer. In ons onderzoek werden 1200 patiënten verdeeld in 3 cohorten, en elk cohort werd behandeld met een andere techniek (respectievelijk Millard, Pfeifer en Afroze).

De Afroze-techniek gaf statistisch gezien een significant beter resultaat dan de Millard- en Pfeifer-techniek voor 6 van de 8 parameters: aansluiting van liprand, aansluiting van lippenrood, uiterlijk van het litteken, cupidoboog, liplengte en symmetrie van de neusgaten. Met betrekking tot de alaire basis en dome scoorde de Afroze-techniek statistisch niet significant beter dan de Millard- en Pfeifer-techniek. Dit leverde voor ons het bewijs dat de Afroze-incisie een goede techniek is voor het herstellen van enkelzijdige schisis.

De Afroze-techniek wordt in ons centrum nu consequent toegepast voor correctie van enkelzijdige schisus.

PRIMAIRE SEPTOPLASTIEK

Neusvervormingen bij enkelzijdige schisis worden gekenmerkt door een prominente asymmetrie die het gevolg is van verstoorde en verschoven structuren[6] (inzakking van de neustop aan de aangedane zijde en verwijde neusvleugels). De alaire basis aan de aangedane zijde is eveneens ingezakt en vaak verticaal verhoogd en de neusvleugelrand is naar buiten gekeerd zodat de binnenkant van de neus zichtbaar is[7-9]. Door de spieronbalans worden het neustussenschot en de premaxilla naar de aangedane zijde getrokken. De neusrug wijkt af naar de niet-aangedane zijde[7-9]. Deze neusvervormingen worden verder gecompliceerd door de verkeerde positie van de skeletbasis.

Er zijn zowel voorstanders als tegenstanders van vroegtijdige neuscorrectie[10]. Randall merkt op dat patiënten zich vaak meer druk maakten om hun vervormde neus dan om hun vervormde lip[11]. Het lijkt er echter op dat vroegtijdige correctie resulteert in minder ernstige secondaire vervorming, en veel vooraanstaande chirurgen herpositioneren de kraakbeenstructuur van de neus nu bij kinderen voordat ze 5 of 6 jaar oud zijn[12,13]. Primaire correctie van neusvervorming tegelijkertijd met lipcorrectie wordt steeds meer toegepast. Hierbij wordt de symmetrie vroegtijdig gerestaureerd door het alaire kraakbeen op te lichten en de columella aan de aangedane zijde te verlengen[6].

Septoplastiek speelt altijd een belangrijke rol in de rhinoplastiekprocedures. Ralph Latham kwam in 1969 met de hypothese dat het neustussenschot de belangrijkste factor is in de hoogte- en anterieure en posterieure dimensies van het gezicht naast die van de neus[14]. Op basis van enerzijds de bewijzen uit de literatuur en met anderzijds de hypothese van Latham- in gedachten, ben ik begonnen met primaire cheiloseptoplastiek om het probleem van de alaire kraakbeentjes en de septale afwijking aan te pakken. Ter validering van mijn methode van primaire

septoplastiek vergeleek ik de resultaten met patiënten die geen primaire septoplastiek hadden ondergaan. De resultaten van de tweedimensionale fotostudie wezen uit dat het neusgat aan de aangedane zijde een betere symmetrie vertoonde bij iedereen in de groep die was behandeld met septoplastiek (significant voor de afstand tussen de columella en cupidoboog, het neusgatgebied en de neusgathoogte, alaire basis en interpupillaire afstand, maar niet significant voor de neusgatbreedte).

PROTOCOL

De conclusies van al deze studies zijn meegenomen bij het opstellen van een chirurgisch protocol dat nu consequent wordt toegepast in ons centrum.

Op basis van het onderzoek uitgevoerd voor dit proefschrift omvat ons protocol voor correctie van enkelzijdige schisis nu primaire lipsluiting met behulp van de Afroze-techniek, functionele herpositionering van alle lip- en neusspieren (waaronder de m. orbicularis oris en m. alar nasalis), primaire septoplastiek en perioplastiek (periostflap om de processus alveolaris en de neusbodem te sluiten). We noemen deze techniek "Afroze Primary Cheiloseptoplasty".

Na afronding van diverse studies naar de effectiviteit van deze techniek zijn we er nu van overtuigd dat "Afroze Primary Cheiloseptoplasty" op dit ogenblik de beste methode is voor de behandeling van enkelzijdige schisis in ons centrum.

VERDER ONDERZOEK

Hoewel de incidentie, de behandelopties en de resultaatmetingen van de behandeling van enkelzijdige schisis uitvoerig zijn belicht in dit proefschrift bestaat er nog steeds een grote behoefte aan aanvullende informatie over de oorzaken van schisis. Momenteel wordt wereldwijd getracht de genen te identificeren die mogelijk schisis veroorzaken. Er zijn ook onderzoekers die menen dat er een verband bestaat tussen schisis en milieufactoren. Hoewel sommige studies een verhoogd risico voor zwangere vrouwen laten zien op het krijgen van een kind met

schisis in relatie tot bepaalde substanties, is hiervoor nog geen afdoend bewijs gevonden. Een centrum met een groot verzorgingsgebied zoals dat van ons biedt zeer veel mogelijkheden op dit gebied.

Een ander interessegebied in dit schisisonderzoek heeft betrekking op de resultaatmeting met gebruik van driedimensionale stereo-fotogrammetrie. Ik heb geprobeerd een dergelijke studie op te nemen in dit proefschrift, maar vanwege technische moeilijkheden was dat niet mogelijk. Wel zijn er vorderingen gemaakt in de ontwikkeling van een protocol voor het uitvoeren van een dergelijke studie. Een publicatie over dit driedimensionale onderzoek zal worden opgenomen in een thesis die specifiek over de problematiek van schisis-neuzen zal handelen.

Als we de kwaliteit van leven van schisispatiënten willen verbeteren zullen we ook meer nadruk moeten gaan leggen op perifere revalidatie zoals educatie, counseling en het scheppen van arbeidsmogelijkheden. Ik hoop dat schisisteams over de hele wereld meer schisispatiënten in dienst zullen nemen om hen te leren hoe ze zorg kunnen verlenen aan toekomstige generaties van schisispatiënten.

Tot slot hoop ik dat alle professionals die betrokken zijn bij de zorg voor schisispatiënten de conclusies van dit proefschrift zullen aanvaarden, zodat de behandeling van enkelzijdige schisis gemakkelijker en efficiënter wordt.

*De universiteiten van Zürich (Zwitserland), Halle (Duitsland), Leipzig (Duitsland), Basel (Zwitserland), het AZ Sint-Jan in Brugge (België), het Dorset Cleft Centre in Poole (Engeland) en de Louisiana State University (VS).

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# CURRICULUM VITAE

Srinivas Gosla Reddy was born in Nellore, Andhra Pradesh on June 21, 1969. He finished his high school from Hyderabad Public School, one of the most prestigious public schools in India in 1986. From 1987 to 1992 he studied dentistry at the HKES Dental College, Gulbarga under the Gulbarga University.

After graduating from dental school with a Bachelor of Dental Surgery he pursued his Masters in Oral and Maxillofacial Surgery in Oral and Maxillofacial Surgery from AB Shetty Institute of Dental Sciences, Mangalore under the Mangalore University and graduated in 1996. He spent four years working and visiting maxillofacial surgical units in Europe to update himself on the latest technologies available in the field of cleft and craniofacial surgery, which was his first love and was associated with the department of Oral and Maxillofacialsurgery of the Radboud University Nijmegen for his PhD-thesis from 2005-2010.

In 1999 he set up the Hyderabad Cleft Society to raise money to build a team and infrastructure to treat poor children with cleft and craniofacial defects free of charge. He is the Director of GSR Institute of Craniofacial Surgery, which provides cleft and craniofacial treatment to 1,500 children every year.

From 2002 he simultaneously attended medical school at the Mediciti Institute of Medical Sciences, Hyderabad under the NTR University of Health Sciences, graduating with a Bachelors degree in Medicine and Surgery in 2009.

He is married to Prashanti for the last 15 years and raises two children, a son, Lalith and daughter, Sudeeksha.